UNIVERSIDAD CARLOS III DE MADRID

TESIS DOCTORAL

INTER-ORGANIZATIONAL RELATIONSHIPS AND PERFORMANCE: A STRATEGIC AND ECOLOGICAL PERSPECTIVE

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DEPARTAMENTO DE ECONOMÍA DE LA EMPRESA

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Resumen y conclusiones

Esta tesis analiza el impacto de las relaciones inter-organizativas sobre el rendimiento a corto y largo plazo de las empresas. Todos los artículos incluyen un análisis cuantitativo de una base de datos que se construyó para esta tesis, y que incluye datos económicos de todas las empresas de ferrocarriles que operaron en España desde el inicio de la industria en 1848 hasta la Guerra Civil Española. El primer trabajo incluido en la tesis examina el peso de las relaciones directas, entre empresas que interactúan la una con la otra, y de las relaciones difusas, entre empresas de la misma industria que no tienen relaciones directas, sobre la mortalidad organizativa. Este capítulo contribuye a la literatura de ecología de las poblaciones y demuestra que la competencia geográficamente localizada y las cooperaciones entre empresas respectivamente aumentan y reducen la mortalidad, pero que el impacto de las relaciones difusas persiste después de controlar por todas las relaciones directas. El segundo artículo examina más detalladamente las relaciones directas entre empresas, y estima el efecto de dichas relaciones sobre la mortalidad, en función de la forma organizativa de las empresas que establecen un acuerdo de cooperación. Contribuye a la literatura sobre redes sociales y ecología de las poblaciones, al demostrar que las conexiones entre empresas tienen beneficios diferentes en función de la identidad y los recursos de cada organización. En particular, se demuestra que algunas estrategias de cooperación pueden ser perjudiciales a largo plazo para las organizaciones que las establecen, y que los efectos de las conexiones pueden ser asimétricos para las dos empresas conectadas. Finalmente, el tercer artículo examina el efecto de distintas estrategias de coopetición sobre el rendimiento financiero de las empresas. Muestra que las estrategias dominadas por la competencia generan más beneficios que las dominadas por la cooperación, pero que este efecto se reduce a medida que crece el número de competidores presentes en el mercado. Este artículo contribuye a la literatura estratégica en general, al mostrar qué relaciones son beneficiales para diferentes estructuras de mercado, y a la literatura sobre coopetición en particular por el uso de una base de datos que incorpora todas las relaciones entre empresas en una industria durante muchos años, en lugar de centrarse en unos casos salientes como han hecho muchos estudios anteriores.

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Chapter 1 - Introduction

How do inter-organizational relationships in a population of firms from a single industry affect their performance? In this dissertation, I address this question in three essays that adopt different theoretical and empirical perspectives.

In the first essay, “Disentangling direct and diffuse ecological processes: The effects of dyadic ties and density on survival” I examine the role of diffuse and direct relationships in an industry on organizational mortality. I draw on the literature in population ecology to examine the dyadic- and population-level forces that affect mortality rates. This essay attempts to provide an answer to the ongoing debate on the nature of diffuse ecological processes that operate at the population-level: some scholars have defended that diffuse competition and diffuse legitimation occur even when two organizations have no direct relationships, while others have claimed that the use of a diffuse measure such as density is only driven by the lack of data on all the inter-organizational relationships in a population, and that diffuse processes only capture the average of these unobserved direct relationships. Thanks to the database that I use in this essay, I am able to disentangle direct and diffuse forces, and to show that population- and dyadic-level forces are of a different nature and simultaneously shape the dynamics of organizational populations.

The second essay, “The liability of connectedness: Organizational forms, network ties and mortality among Spanish railway companies, 1848-1935”, analyzes in greater depth the impact of ties between firms on organizational mortality. It distinguishes between different types of ties, depending on the organizational form of the organizations that connect to each other. It draws on the literature on population ecology and social networks to examine how ties between different organizational forms affect organizational mortality, and questions the idea that ties between organizations are beneficial under any circumstances. In this essay, I claim that ties do not only mitigate competition between firms and give access to important resources, which increases survival chances, but that they can also affect a firm's identity in a positive or negative manner. I show that when ties are formed between organizations of a different form, they can create a liability of connectedness and increase mortality rates.

Finally, the third paper, "Exploring the link between coopetitive strategies, industry structure and firm performance", assesses the effect of cooperation and competition strategies on financial performance. In particular, it examines how the choice of a specific balance of competition and cooperation in the relationships with its partner affects an organization's income, and how this relationship evolves under different industry structures. This essay draws on the literatures on coopetition, multimarket contact and competitive aggressiveness, and contributes to the literature in strategy by empirically testing the consequences of different coopetition strategies on performance and showing under which conditions these strategies should be chosen.

The empirical testing of the propositions developed in the three essays relies on a single database that was specifically gathered for this dissertation. In order to study the effect of the complete set of interorganizational relationships in a population, I chose an industry in which these relationships were easily observed and reliably tracked. The Spanish railway industry provided an ideal setting for the three studies in this dissertation, because direct relationships between organizations are limited by the geographical situation of each company – railway companies can only engage in direct rivalry or cooperation when they are both active in the same city – and because the relevance of the industry and its regulation implied that all such relationships were tracked. Furthermore, all the information that is available on this industry has been stored in the Railway Historical Archives (AHF, *Archivo Histórico Ferroviario*) in Madrid, which is open to the public. I gathered data for the whole period of operation of the railway companies under competitive conditions, from the opening to public service of the first railroad between Barcelona and Mataró in 1848 to the last year before the Spanish Civil War, which started in 1936 and after which most railways were nationalized and merged into a single State-owned entity.

The first step in building this database was to create a complete and reliable census of the industry. The main source of information were the annual directories of the railway companies that were published by a civil engineer working for one of the major railway companies, la *Compañía de los Caminos de Hierro del Norte de España* (Northern Spain Railway Company). The information contained in these directories (La Torre, 1893-1935) was easy to exploit and very complete. It included many valuable financial figures, particularly for the major companies, such as annual number of passengers, tons of freight and income. However, there were two major problems in relying on these directories to build the census: firstly, some of the companies were still included for a few years after shutting down, which could lead to errors in assessing the causes of their closure (for Chapters 2 and 3), and secondly, the directories did not exist before 1893, which left an important period uncovered.

Two additional secondary sources, published by the Foundation of Spanish Railways (FFE, *Fundación de los Ferrocarriles Españoles*), which hosts the AHF, allowed solving the abovementioned problems. García Raya (2006) uses archival data to develop a very complete and accurate chronology of most openings of tracks and which company they belonged to, and if a road was eventually closed, it reports the year in which that happened. Muñoz Rubio (2006) includes all the openings of narrow-gauge railway tracks. These two publications allowed me to check the reliability of the data and to get access to the information that was missing from the annual directories. Because only García Raya's (2006) paper was available in electronic format, the coding of the census was difficult: after building a first version of it, I compared it again with the original sources and eliminated some errors.

Once the census of the Spanish railway population was completed, I gathered data on the localization of the tracks operated by each company and its evolution from year to year, in order to get information on the local competitors and partners that every firm had. In the dissertation, I considered that two companies were connected if they share a station, where passengers and goods could easily make a connection between the two companies' trains. The rationale for that is explained in more detail in the following chapters. Because some companies had thousands of kilometers of tracks and hundreds of stations, I only focused on the approximately 140 cities that were served by two or more companies at some point in time. The first method for approaching that number and the relationships between companies in these cities was to use the maps included in La Torre directories, which gave a good idea of the places where connections occurred but were not available from the AHF for all years. I started with the first year of my dataset, and tracked all the openings of tracks that took place in each year to update the count of companies operating in each of the potential connecting point. When two companies operated in the same city, I coded them as partners if they shared a station using the information on the ownership of each station tracked in García Raya (2006) and Muñoz Rubio (2006), and coded them as local competitors otherwise. I had to be particularly careful when a company was acquired by another to take into account the transfer of its tracks to the acquiring firm. Information on changes in ownership was extracted from Artola (1978), García Raya (2006) and Muñoz Rubio (2006). I used yearly changes in the number of kilometers of tracks operated by each company to make sure that all the newly owned or opened tracks were included in my matrices. Finally, when the coding was completed, I checked the accuracy of the matrix for the final year, and did the same process again backwards, starting from 1935 and correcting the errors in the coding. Finally, I checked that the matrices were symmetric (meaning that if firm A was connected to B, B was also reported as connected to A) to ensure that the number of coding errors was minimal.

The number of passengers transported by each company on each year and its income were taken from the annual directories, and for the years previous to its existence, from the two major periodical publications of the industry, the *Revista de los Caminos de Hierro* (the Review of Railways) which was first published in 1856 and from the *Gaceta de los Caminos de Hierro (*the Gazette of Railways*)*, which started publishing in 1866. Since the companies had to send their annual financial reports to these journals, the information in these publications is very complete and accurate. Finally, some of the missing figures were found in the *Revista de Obras Públicas* (the Review of Public Works) which was edited by the Ministry of Public Works and where financial reports were published before the creation of specific industrial publications. I also used the tables in the appendix of Muñoz Rubio (2006), which gather information that was extracted from the companies' annual reports. The Review of Public Works was the only one of these sources that existed in electronic version.

The construction of this database is the first contribution of this dissertation. The three essays which use this dataset are included in Chapters 2, 3, and 4, while Chapter 5 presents the general contributions, limitations and conclusions of this dissertation.

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Chapter 2 - Disentangling direct and diffuse ecological processes: The effects of dyadic ties and density on survival

Researchers in population ecology have long recognized the necessity to account not only for diffuse relations between organizations of a single population, as assessed in density-dependence theory (Carroll & Hannan, 1989), but also for dyadic relationships between specific organizations (Baum & Korn, 1996, 1999; Baum & Singh, 1994) to explain birth and mortality rates in organizational populations. However, because data on dyadic relationships over long periods of time are difficult to gather, most ecological studies have only used density and assume that it captured the average effect of dyads. This assumption has been challenged by population ecologists, and there is an ongoing debate on "whether diffuse competition as modeled in the basic density model captures a distinct process or simply represents a good shorthand approximation to direct competition averaged across an entire population" (Carroll & Hannan, 2000: 230). The focus on diffuse processes has also fostered criticisms on the capacity of population ecology to approximate industry evolution (Durand, 2006).

Studies in which dyadic ties have been explicitly considered along with diffuse processes as drivers of vital rates have emphasized one aspect of inter-organizational relationships, namely competition (e.g. Baum & Haveman, 1997; Baum & Mezias, 1992), rather than the consequences of cooperation (Singh & Mitchell, 1996), but none has taken both facets into account. In this paper, I measure both dyadic competition and dyadic cooperation, while controlling for diffuse processes through a measure of density, in order to test for the coexistence of direct and diffuse ecological processes in shaping mortality rates in a population.

Knowing whether diffuse processes represent a distinct phenomenon or whether they are observed when some of the effects of dyadic ties are omitted is not only relevant for population ecologists: if diffuse and direct processes coexist to shape industrial demography, as my results indicate, then research in organization studies has to focus on the differences between these phenomena, the different drivers of both, and the resulting effect of these forces under diverse circumstances.

I use data from the Spanish railway population, in which dyadic relationships are easy to track for the full period of analysis. In this population, market contacts between organizations can be of two types: cooperative ties occur when railway companies share a station in a city, so that trains can pass easily from the roads of one company to those of the other, and the companies need to coordinate on fares, schedules and other operating matters; competitive dyads are those between companies which serve the same city but operate from different stations and do not share tracks. I also include a population density measure to control for diffuse processes which may not be captured by my measure of direct relationships – cooperative or competitive – between organizations.

My results show that cooperative ties increase the probability of acquisition, and reduce the probability of failure, especially when connections are numerous. Direct competition reduces the probability of acquisition but does not significantly affect the probability of failure. Finally, I find that density-dependent processes persist after accounting for dyadic relationships, thus showing that in the Spanish railway industry diffuse processes are not a measure of direct processes averaged over the population, but correspond to a different phenomenon that is not captured by the set of dyadic relationships in the population.

These results are important first because they contribute to the debate on whether diffuse processes exist independently from other processes in industrial populations and second because some studies have looked at the effect of connections to external actors on survival (e.g. Baum & Oliver, 1991; Cattani, Ferriani, Negro, & Perretti, 2008; Miner, Amburgey, & Stearns, 1990), but very few have examined cooperative ties within a population.

In the next section, I discuss how cooperative dyadic ties affect mortality, and explain why diffuse processes may persist when dyadic ties are taken into account. The methods section presents the data used in this study, and shows how I measure direct processes and model mortality rates as a function of both direct and diffuse processes. In the results sections I present my main findings and explain what they mean for mortality dynamics. The concluding section discusses how these results fit into the debate on the nature and importance of direct and diffuse processes in ecological models, and advocates for combining the two perspectives in studies of organizational demography.

DIRECT AND DIFFUSE ECOLOGICAL PROCESSES IN ORGANIZATIONAL DEMOGRAPHY

Ecological models have originally assessed population dynamics based on diffuse relationships between firms, as measured by density, the raw count of organizations in the population (Carroll & Hannan, 1989). Density-dependent dynamics of the population reflect two processes, legitimation, which increases survival chances, and diffuse competition, which increases mortality. Both processes have a higher impact on survival chances when the number of organizations in the population is larger. The combination of these processes yields a curvilinear effect: survival chances first increase with the number of organizations, until an inflexion point where the negative effect of competition becomes larger than the positive effect of legitimation.

Similarly, two distinct direct processes are suggested to affect the survival chances of population members: direct competition (Hannan & Freeman, 1989) and cooperation – through partnerships or alliances. Direct competition differs from diffuse competition because it occurs between two organizations that are "directly identifiable to each other" (Baum & Korn, 1996: 255) and depends on the overlap of the resources on which they draw (Baum & Singh, 1994; Hannan & Freeman, 1977; McPherson, 1983). Cooperation occurs when two organizations establish relations with each other in order to pursue some common goal.

Because the goal of the paper is to examine the persistence of diffuse processes after including competitive and cooperative processes, I first provide hypotheses regarding the effect of cooperation on population survival rates, and then hypothesize on the persistence of diffuse processes after controlling for direct processes.

Cooperative dyadic ties and mortality

While some ecological studies focus on the effect of direct competition on population dynamics, research exploring the effect of cooperative ties between population members on mortality rates is underdeveloped. Most studies tend to focus on ties to external actors (e.g. Singh, Tucker, & Meinhard, 1991). These ties are found in a variety of settings to increase survival chances as predicted by resource dependence (Pfeffer & Salancik, 1978) and institutional theory (Meyer & Rowan, 1977; Oliver, 1991). A study on nonprofit organizations (Hager, Galaskiewicz, & Larson, 2004) explains failure of young organizations as a consequence of their lack of structural embeddedness. It finds that social capital and institutional ties of nonprofit organizations interact with the liability-of-newness effect in shaping the demographic evolution of the organizational population. Connections to political parties are found to buffer Finnish newspapers from environmental turbulences (Miner et al., 1990). Similarly, in a study of U.S. feature film producers (Cattani et al., 2008) it is shown that the degree of connectivity and repeatedness of interactions within an inter-organizational network increase survival rates.

An unexplored but potentially critical factor influencing firms' survival is the development of cooperative ties with organizations within the population. As it occurs for ties to external actors, these ties may provide firms with additional resources that improve performance. Evidence suggests that stable interorganizational networks increase access to resources which in turn reduces mortality rates (Brass, Galaskiewicz, Greve, & Tsai, 2004). Failure of a partner within a population was found to increase mortality rates (Singh & Mitchell, 1996). This result suggests that cooperative ties have an effect in enhancing survival chances. In my setting, cooperation between two railway companies is likely to increase the traffic volume of both companies, as it enhances the access of passengers and goods to a higher number of locations. Increased traffic improves financial performance and reduces the probability of failure.

Because organizations can cease operations as an independent entity for a variety of reasons, I also examine the effect of cooperative dyadic ties on the probability of acquisition. Since railroad companies with connections to other railroads are less likely to fail, they will be perceived as attractive takeover targets. This expectation is consistent with the large number of studies showing that acquired firms are often not poorly managed but rather attractive ones, for example, because they have a large market share or operate in areas that are rich in customers (Agrawal & Jaffe, 2003; Hannan & Rhoades, 1987). More importantly, one of the major aims pursued by mergers and acquisitions is to develop synergies between the two firms (Cigola & Modesti, 2008; Larson & Gonedes, 1969) and organizations that present complementarities to the focal firm before acquisition– in this setting, because their railroads are connected to the focal firm's network – are the acquisition targets that are most likely to yield such synergies. In the railway setting in which the initial fixed costs of building a new railroad are extremely high, connected railway companies are a convenient acquisition target as they allow for an extension of the network without experiencing the cost of building new infrastructures, such as roads and stations. Acquiring unconnected railroads is more costly, because the acquirer would have to build tracks linking its network with the roads of the acquired firm in order to benefit from synergies and the net effect of the acquisition is less likely to be positive.

For these reasons, I expect the following relationships between cooperative ties and the probabilities of exit by failure or acquisition:

- *Hypothesis 1a: Cooperative ties between organizations reduce their probability of failure*
- *Hypothesis 1b: Cooperative ties between organizations increase their probability of being acquired*

Persistence of diffuse processes

Diffuse processes will persist after controlling for direct relationships of cooperation and competition if they capture a collective process occurring at the population-level instead of the average of all dyadic processes in the population.

Since very few studies have looked simultaneously at cooperative and competitive dyadic ties, it has been impossible to test directly whether a diffuse process still takes place after controlling for all dyadic relationships. However, there are a number of theoretical reasons and some empirical evidence supporting the existence of collective processes together with dyadic relationships. Arguments on the collective learning induced by population ageing, which differs from organization ageing (Hannan, Carroll, Dobrev, Han, & Torres, 1998) or on the influence of collective identity on mortality rates (Swaminathan, 2001) highlight some of the processes occurring beyond the dyadic level that are not captured by measures of direct competition and cooperation alone.

Studies of a community of early telephone companies have shown that collective action affects population dynamics in a way that is not fully captured by density models: the “liability of collective action” (Barnett, 1994) is observed when some companies simultaneously experience direct benefits from contacts with the major operator and suffer from the diffuse competition generated in the population by an increase in the number of active organizations. Barnett and Carroll (1987) find that both direct and diffuse competition can occur simultaneously between organizations, depending on the intensity of their relationships, and also observe that in some cases, symbiosis seems to exist between organizations that compete with others at a diffuse level, although they do not have data on dyadic ties to further support this claim.

Conversely, a study on network structure in the airline industry finds that the network measures used to predict mortality rates perform better than the usual concentration measures, supporting the idea that direct processes between connected organizations are not fully captured by diffuse processes reflected in density and concentration models (Seidel, 1997). Thus, it seems that measuring either direct or diffuse processes separately is not enough to explain the dynamics of industrial evolution.

Calls for the development of community ecology examining ecological processes among organizational forms linked by a collective identity and acting interdependently (Freeman & Audia, 2006; Ruef, 2000) have come from the necessity to enhance the understanding of the set of diffuse and direct forces that shape corporate demography.

Thus, I expect that:

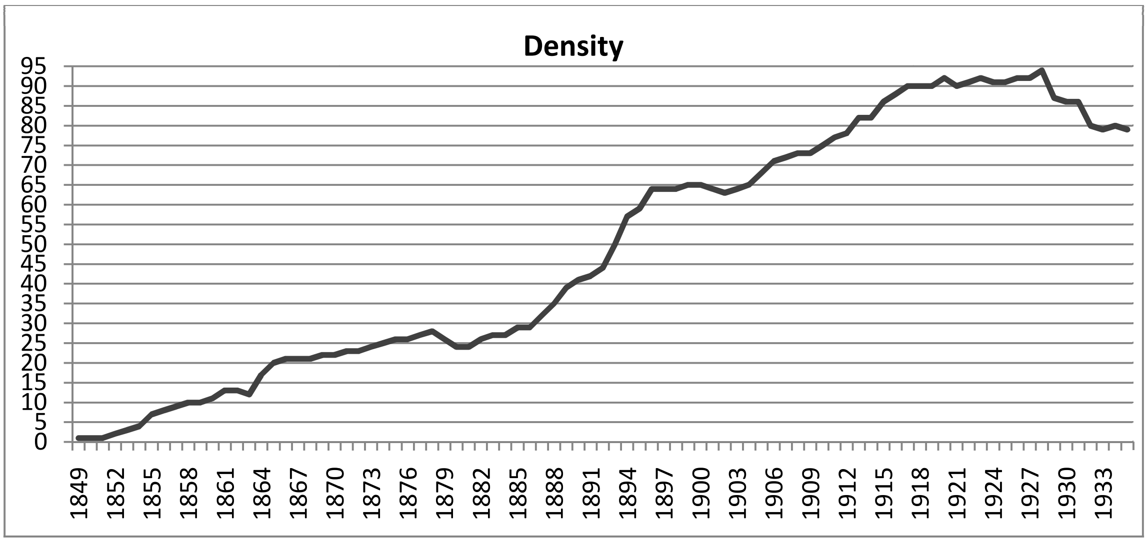
- *Hypothesis 2: Density-dependent processes persist when controlling for direct ecological processes*

DATA AND METHODS

The Spanish railway industry, 1848-1935

My dataset is formed by the 146 railway companies that operated in Spain at some point during the period 1848-1935. I focused on those years because they correspond to the full period of competitive operation of the Spanish railway sector. In 1848, the first Spanish railroad opened between the stations of Barcelona and Mataró. 1935 was the last year of normal operation of the Spanish railways before the Spanish Civil War which interrupted the service on most roads and destroyed infrastructures. Immediately after the end of the Civil War, Franco's dictatorship decided to nationalize the large majority of the railway companies and group them into a single state-owned company.

Figure 1: Density of Spanish railway companies, 1848-1935



The number of railway companies operating in Spain varied between 1 in 1848 and its maximum number of 94 in 1928. The density measure was obtained from the census of the population that I built from Latorre directories (1893-1935) and, for years previous to 1893, from the two weekly journals of the industry, the *Gaceta de los Caminos de Hierro* and the *Revista de los Caminos de Hierro*.

The reliability of the data used to build the census was cross-checked using two additional sources, on the opening on railroad sections since 1848 (García Raya, 2006) and a book on narrow-gauge railways (Muñoz Rubio, 2006), both based on primary archival data.

All the companies in this population transported passengers (although 2 companies in my dataset operated for a few years with freight only before including passenger service) and most transported freight as well, with the exception of some short-distance suburban companies that were dedicated to passenger transportation only. The roads were assigned by the State through an auction mechanism. The winning company obtained the exclusive right to exploit the road but competitors could serve the same stations indirectly: for example, only one company had a direct railroad from Madrid to Zaragoza, but another company offered the possibility to go from Madrid to Zaragoza through Valladolid and Burgos. Since speed was not a determinant factor in the decision to ride a specific train (Bennassar, 1992), at least before the development of car transportation in the 1920s, companies that served the same cities could be considered as competitors even if one was faster than the others in reaching the final destination.

The model

I test my hypotheses on the impact of diffuse and direct processes on mortality rates through a multinomial logit model, which estimates the probability of the different exit types for each company depending on the direct connection, direct competition and density variables.

I use a competing risks model because the exit event can be of two types, acquisition and failure. In this setting, I group two forms of failure under one single category: failure of firms that run out of business and whose roads close, and failure of firms whose roads were acquired by the State: during my whole period of analysis and until the end of the Spanish Civil war, the State only acquired companies out of economic reasons, i.e. because the private activity was not profitable, and not for ideological reasons as it happened at the beginning of Franco's dictatorship (Artola, 1978). Thus I measure the probability of 1) being acquired or 2) failing (by closure or acquisition by the State) with respect to the probability of event 0, non-exit.

Independent variables

I build my direct competition and cooperation variables in the following way: in each geographic point that was served by more than one railway company, these companies had two options for dealing with local competitors. They could choose to cooperate by sharing a station, which meant that their roads were connected to each other and passengers could change trains from one company to another in that station. It also implied that they had to coordinate on fares, schedules and accounting systems. They could use the other company's roads to transport freight in their own trains, and could sell train tickets from one of their stations to a final destination served by their partner.

In the case that they chose not to cooperate, they operated from different stations in the same city[1] and their roads did not connect to each other. They did not have to coordinate on any managerial aspect, but the lack of cooperation was likely to derive in more intense rivalry.

I collected data on the market contacts of railway companies for each year from the maps in the Latorre (1893-1935) directories and from the information on every road contained in García Raya (2006) and Muñoz Rubio (2006).

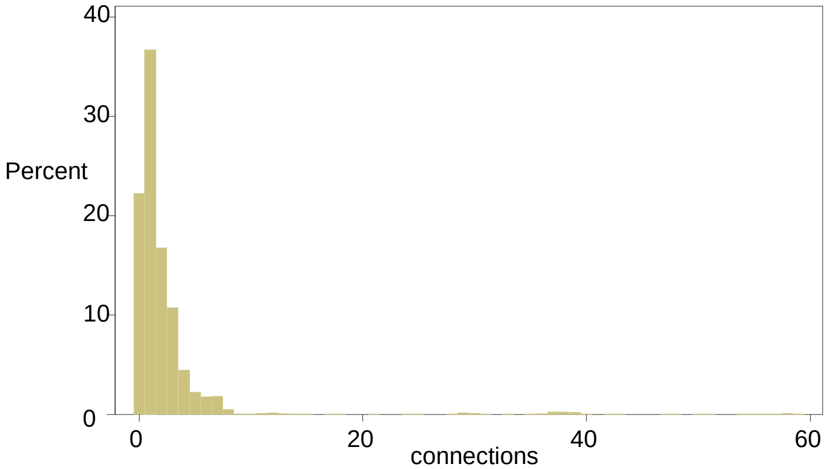
My variables are then based on the number of places in which an organization has market contacts with others: if these market contacts are of cooperative nature, i.e. if the companies connect to each other in at least a station, I consider them to be engaged in (direct) cooperation; if these contacts are non-cooperative, I consider the organizations as rivals, or direct competitors. I obtain for the full period of analysis the number of 5148 connection points-year and 3590 direct competition points-year. The balance between these two numbers shows that the railway companies in my sample could choose between the two strategies, and that although cooperation was more frequent, it was not systematically preferred.

Because the number of connections is equal to 1 for a majority of organizations, as it appears in Figure 2, and the variability tends to be concentrated on whether a railway company had 0, 1 or more than 1 connection, I build, instead of a discrete variable counting the number of connections, two dummy variables: “number of connections = 1” and “number of connections > 1”, with organizations with no connections being the omitted

[1] Since some stations consisted of a precarious wooden building on the side of a track (Muñoz Rubio, 2006), I do not believe that the decision to build a station or not was driven by the amount of capital available for investment.

category. For direct competition, I count the number of direct competitors for each company.

Figure 2: Histogram of the number of connections in the Spanish railway population, 1848-1935.



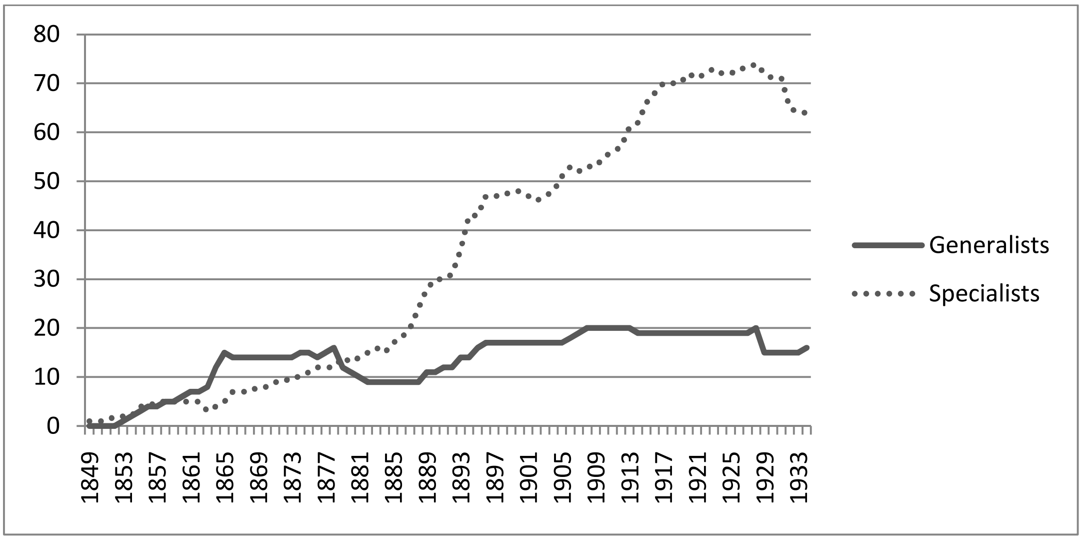
Control variables

I include the density variable along with the direct competition and cooperation variables in order to test for the persistence of diffuse processes after accounting for direct effects. Density is operationalized in the usual way, as the number of organizations in the population for any given year (Carroll & Hannan, 1989). Because I want to be sure that I am assessing the processes of diffuse competition and legitimation, I measure density for a specific form, i.e. generalist of specialist, instead of the density for the full population. In that way, I try to avoid capturing effects that may be correlated with density at the population level (e.g., political cycles) but do not directly relate with the processes that I intend to measure. The squared term for form density is also included, as a curvilinear relation has been observed in the majority of studies conducted over diverse populations (see Carroll & Hannan, 2000, for a review of these studies).

I distinguish in my population between generalists and specialists based on the roads that they operate. In this setting, with a few exceptions all companies transported both passengers and freight, so that it does not make sense to base the distinction between generalists and specialists on service type. Instead, I consider that generalists are those organizations that serve regions of the resource space that are rich in resources, i.e. those that connect areas of major economic activity. In order to distinguish between roads of major importance and others, I use an external source, the reports of the Spanish Railway Commission formed by engineers and members of the parliament.

These reports define the roads that were of high priority for the economic development of Spain, and ought to be built before any other. Roads that were considered of high priority were those connecting two or more large cities or important economic centers such as ports. For example, railroads between Madrid and all major cities (Barcelona, Zaragoza or Valencia) or important ports like Bilbao or Cadiz were all included in the Railway Commission lists. Because of the economic importance of these axes, the potential demand for these railroads was much higher that the demand for railroads serving points without these characteristics. The priority plans defined by this Commission are described in Artola (1978). However, the roads were not built in the order established by these plans due to corruption and political turmoil. Thus, the priority plans only give us information on the potential demand for these roads, and being included in these plans is not necessarily correlated with other factors such as earlier founding or obtaining subsidies for building that could bias my results. I consider a railway company to be a generalist if it operates one or more of the roads included in the priority plans, and a specialist if none of its roads is part of a priority plan. This variable varies over time for the companies: a company is only considered as a generalist after the road included in a priority plan is built, and not for its full history. The evolution of the density of generalists and specialists during my period of analysis is represented in Figure 3.

Figure 3: Density of Spanish railway companies by organizational form, 1848-1935



I also include a number of control variables, such as the natural logarithm of age which controls for temporal dependence, the natural logarithm of the number of passengers, to control for organizational size[2], obtained from Latorre directories (1893-1935), the *Gaceta de los Caminos de Hierro* and the *Revista de los Caminos de Hierro*. I also include the log of the Gross Domestic Product

[2] In fact, I measure size as ln(number of passengers+1) to avoid dropping a few cases with zero passengers in a specific year, for example before a company started passenger transportation. The number of passengers is very strongly correlated with other variables such as income or tons of freight transported, but it has less missing observations.

for each year, which captures economic cycles, from Carreras and Tafunell (2005).

Table 1 displays the means, standard deviations, minimum and maximum values, and correlations for the variables included in my model.

Table 1: Descriptive statistics and correlations

	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9
1. #connections=1	0.35	0.48	0.00	1.00	1.00								
2. #connections>1	0.45	0.50	0.00	1.00	-0.66 (0.00)	1.00							
3. Direct competition	1.81	3.91	0.00	28.00	-0.17 (0.00)	0.16 (0.00)	1.00						
4. Form density	44.58	24.01	1.00	74.00	0.21 (0.00)	-0.19 (0.00)	-0.21 (0.00)	1.00					
5. Form density ^{2} /10	256.35	203.98	0.10	547.60	0.19 (0.00)	-0.18 (0.00)	-0.20 (0.00)	0.99 (0.00)	1.00				
6. Age (Log)	2.78	0.92	0.00	4.42	-0.05 (0.00)	0.20 (0.00)	0.24 (0.00)	0.17 (0.00)	0.18 (0.00)	1.00			
7. GDP (Log)	15.51	0.32	14.65	15.98	0.05 (0.00)	0.12 (0.00)	0.05 (0.00)	0.63 (0.00)	0.63 (0.00)	0.45 (0.00)	1.00		
8. Passengers (Log)	12.32	1.93	0.00	17.23	-0.19 (0.00)	0.29 (0.00)	0.47 (0.00)	-0.14 (0.00)	-0.13 (0.00)	0.24 (0.00)	0.05 (0.00)	1.00	
9. Specialist	0.70	0.46	0.00	1.00	0.20 (0.00)	-0.35 (0.00)	-0.28 (0.00)	0.79 (0.00)	0.74 (0.00)	-0.06 (0.00)	0.24 (0.00)	-0.30 (0.00)	1.00

RESULTS

The population of Spanish railway companies was formed of 146 organizations, 68 of which disappeared over the 1848-1935 period (45 were acquired and 23 failed). The results of the estimation of the effects of direct and diffuse interorganizational relationships on the competing risks of failure or acquisition are presented in Table 2.

My results support H1a which states that connections between firms reduce the probability of failure, although this effect only appears when the number of connections becomes higher: the second column of Table 2 shows a negative effect of connections on the probability of failure, but only for organizations with more than one connection. When the number of connections is equal to 1, the effect fails to be significant.

Table 2: Multinomial logit regression table of the probability of mortality for Spanish railway companies, 1848-1935

	(1)	(2)
VARIABLES	**Dies=1 (acquisition)**	**Dies=2 (failure)**
#connections=1	1.318**	-0.760
	(0.589)	(0.577)
#connections>1	1.446**	-1.136*
	(0.586)	(0.640)
Direct competition	-0.160*	-0.0697
	(0.0879)	(0.0979)
Form density	-0.0886**	0.660*
	(0.0399)	(0.342)
Form density ^{2} /10	0.00828*	-0.0547**
	(0.00454)	(0.0263)
Age (Log)	0.194	0.730*
	(0.212)	(0.400)
GDP (Log)	-1.356*	6.535***
	(0.767)	(1.642)
Passengers (Log)	0.240*	-0.175
	(0.140)	(0.113)
Specialist	0.815*	-10.22*
	(0.489)	(5.976)
Constant	13.21	-116.7***
	(11.62)	(26.64)
Observations	3595	
Log-likelihood	-334.6	
Df	18	
Chi2	92.06	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Similarly, H1b, on the positive effect of connections on the probability of acquisition, is supported: in the first column of Table 2 showing the probability of acquisition, the connection variables display a positive coefficient. In this case, I find stronger support for H1b since the effect is significant even for a single connection, and is stronger when the number of connections increases.

The effect of direct competition is only significant on the probability of acquisition, which it decreases, while it does not affect the probability of failure.[3] These results could be related to the specific nature of my dataset: in my setting, having a large number of direct competitors could indicate that a firm operates in an area that is richer in resources and which carrying capacity is higher. However, I cannot measure the carrying capacities of the different niches in this setting and thus cannot directly test this intuition. While intense competition is likely to increase the probability of failure and acquisition, the effect of drawing on a richer niche is the opposite and the resulting net effect is hard to predict.

I also find support for H2, which states that diffuse processes persist after controlling for the effect of dyadic ties between firms. Interestingly, I find a curvilinear effect of form density on the probability of failure, but I find that the linear effect is positive. This means that density increases the probability of failure until a point when the effect starts to decrease. This result could indicate that after controlling for the effects of cooperation and direct competition, the diffuse process that affects population mortality is mainly diffuse competition, which increases mortality rates. This is also supported by the opposite effect that I find on the probability of acquisition, which is lower when density is low, and becomes positive when the density increases. Since the effect of diffuse competition on the probability of acquisition is likely to be positive – in competitive settings, one strategy for growing and surviving is to acquire

[3] I also tried to include the effect of multipoint competition together with direct competition in our model, but it failed to be significant.

competitors – this finding is likely to support the idea that diffuse competition persists more than legitimation after controlling for direct ecological processes.

The effect of diffuse processes on the probability of acquisition is much lower than on the probability of failure. This explains why population ecologists tend to focus on mortality by failure and not by acquisition when they assess density-dependent population dynamics. However, even at very low levels, an increase in the number of diffuse competitors has a high positive impact on the probability of failure, while a change in the intensity of direct competition has no significant impact. This shows the importance of combining measures of direct and diffuse processes in assessing mortality rates in an organizational population.

My control variables indicate that specialists are less likely to fail and more likely to be acquired than generalists. This is consistent with the prediction of the resource-partitioning theory (Carroll, 1985). Age significantly affects the probability of failure, a result that is also consistent with ecological theory (Freeman, Carroll, & Hannan, 1983), but has no effect on the probability of acquisition. The fact that age is positively related with the probability of failure reflects the “liability of adolescence” (Bruderl & Schussler, 1990) that affects firms with a large initial endowment. In the case of railway companies, this is consistent with the high investment in fixed assets required to build the roads.

DISCUSSION AND CONCLUSION

In this paper, I estimate the failure and acquisition rates in the population of Spanish railway companies between 1848 and 1935 as a function of dyadic cooperative and competitive ties and density and the results provide support for my hypotheses. Cooperative ties between members of the organizational population increase acquisition rates and decrease failure rates, and these effects occur simultaneously with the processes of diffuse competition and legitimation at the population level.

Support for the positive effect of cooperative ties suggests that cooperation tends to increase the chances of success in the population that I study, but cooperative ties also increase organizations' attractiveness for acquisition. This finding is consistent with the idea that cooperative ties are a form of social capital (Burt, 1992) which increases the probability of success of organizations involved in partnerships. In the same line of Cattani et al. (2008) who find a negative effect of ties to external actors on mortality, I find that ties to organizations within the same population also decrease mortality rates.

An interesting finding which contributes to the debate on the nature of direct and diffuse ecological processes is that density significantly affects mortality rates after controlling for dyadic ties of both forms – competitive and cooperative. This finding provides evidence against the claim that diffuse processes are a good approximation of the average of direct processes in a population. I find evidence for the assertion that direct and diffuse ecological processes are not only of a distinct nature, but also that they act in different directions.

Diffuse processes have little impact on the dynamics of mergers and acquisitions in a population but they substantially affect the success or failure of population members. Conversely, the effect of direct processes is more important on acquisition rates than on failure probabilities. This effect seems to indicate that acquisitions and failures are driven by different forces that occur simultaneously in a population and that in order to fully understand population dynamics, one should not focus on a single aspect, either dyadic relationships or population-level forces, but combine the two perspectives.

Direct processes are driven by the strategic behavior of individual firms which decide on the kind of dyadic relationships that they want to build, while diffuse processes depend on the collective behavior of the population or the form as a whole. Strategists have focused mostly on the former, while population ecologists have explained industrial demography mostly based on the latter. My results show that both approaches are important factors in explaining the evolution of populations and that it is necessary to jointly capture the two.

This study presents a number of limitations. First, my operationalization of cooperative and competitive dyadic ties is specific to the context of the Spanish railway industry and could not be extended to different settings. As a consequence of this limitation, my results might not be generalizable to different contexts. Also, I do not look at the intensity of dyadic relationships, but treat all relationships as equal in my analysis. It is likely that the effect of dyadic cooperative and competitive ties varies with the strength of such ties. However, I could not assess this issue with the data that were available to us.

To conclude, I suggest that further research on the co-evolution of population-level and organizational-level processes is necessary, not only for organizational theory development, but also to draw the attention of practitioners on processes that transcend the barriers of the organization and significantly affect organizational performance. My study provides a step in this direction by showing that processes at the population and organizational levels co-exist to shape industrial dynamics. Taking into consideration my findings and the limitations of the present study, I call for studies combining direct and diffuse processes as drivers of population dynamics across a variety of settings. Future research in this area should also look at the effect of varying intensities and asymmetries in dyadic relationships on mortality rates.

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Chapter 3 - The liability of connectedness: Organizational forms, network ties and mortality among Spanish railway companies, 1848-1935

Research assessing the effect of a firm's network ties on organizational outcomes has shown the theoretical and practical importance of network ties to understand firms' behavior and performance (Lavie, Lechner, & Singh, 2007; Powell, Koput, & Smith-Doerr, 1996). Most research in this direction has explored the effect of ties to partners outside the focal firm's population as a key factor influencing performance. Ties to outsiders have been demonstrated to affect innovation (Ahuja, 2000), financial performance (Shipilov, 2005, 2006; Shipilov & Li, 2008; Zaheer & Bell, 2005), act as a buffer from environmental uncertainty (Miner, Amburgey, & Stearns, 1990) and increase legitimacy (Cattani, Ferriani, Negro, & Perretti, 2008), thus reducing mortality rates.

Yet, in spite of the consensus that cooperative ties - or network ties, equivalent in this paper - matter, the specific effects of cooperative ties to partners within the same population on organizational outcomes remains underexplored. Moreover, while most studies have focused on network ties as a determinant of organizational-level outcomes, little is known about the effect of ties on population-level dynamics (Baum, Calabrese, & Silverman, 2000). I suggest exploring how the structure of a firm's cooperative ties to partners within the same population affects mortality rates and thus shapes population dynamics.

Because organizations within a population vary depending on their initial position in the resource space, cooperative ties to partners placed in different positions may not have similar effects on survival. In this study, I distinguish two organizational forms, generalists and specialists, depending on their position in the resource space, and assess the effect of cooperative ties between and across these organizational forms on survival rates.

As a setting, I use the population of Spanish railway companies since the inception of the industry in the year 1848 until 1935, which is the last year of competitive operation before the Spanish Civil War (1936-1939) and the posterior nationalization of the railway service in 1940. This setting is particularly useful for testing my arguments because dyadic ties between organizations are easy to track since market contact is observable through the location of roads and stations. Market contacts between organizations can either be of a cooperative or a competitive nature. In this population, cooperative ties occur when railway companies share a station in a city, so that passengers and freight can pass easily from the roads of one company to those of the other, and the companies need to coordinate on fares, schedules and other operating matters; competitive dyads are those between companies which serve the same city but operate from different stations and do not share tracks. My hypotheses focus on the effect of cooperative ties, although I include competitive dyads as a control. I predict that initial differences in available resources and form identities between generalists and specialists will affect the benefits that these organizational forms will derive from cooperation with partners of the same or different form.

In contrast to Barnett and Carroll’s (1987) hypothesis that networks of firms have mutualistic interdependences and reduce partners’ mortality, my results suggest that connections to an organization of the same form reduce mortality, but the presence of a liability of connectedness increases mortality rates for generalists when they engage in cooperative ties with specialists. I also find that some ties have an asymmetrical effect on survival chances, since ties across forms reduce survival chances for one form (generalist) while they do not affect the mortality rates of specialist organizations. These results show that not only the existence of ties matters, but that the parties that are connected affect the properties of ties: cooperation strategies interact with the initial location of organizations in the resource space in determining the resources, legitimacy and intensity of competition that affect an organization's survival chances.

The remainder of this paper is organized as follows: the next section proposes a series of hypotheses linking cooperative ties, the nature of the organizations that cooperate and survival chances. The data and methods section describes cooperative and competitive dyadic ties in the Spanish railway population during its years of competitive operation, from 1848 to 1935, discusses the operationalization of my variables and the empirical model used in testing these hypotheses. The following section exposes my results. Finally, I conclude by discussing the main results, their implications and the limitations of the present study.

DYADIC TIES AND SURVIVAL

Two types of dyadic relationships are suggested to affect the survival chances of population members: direct competition – also termed rivalry (Baum & Korn, 1996; Hannan & Freeman, 1989) - and cooperation through partnerships or alliances. Direct competition occurs between two organizations that are "directly identifiable to each other" (Baum & Korn, 1996, p.255) and depends on the overlap of the resources on which they draw (Baum & Singh, 1994; Hannan & Freeman, 1977; McPherson, 1983). Cooperation occurs when two organizations establish relations with each other in order to pursue some common goal.

While many studies have focused on the dynamics of dyadic competition, research on the impact of cooperative ties within a population on survival rates is underdeveloped. Most studies tend to focus on ties to external actors (e.g. Tucker, Singh, & Meinhard, 1990) and find a positive relationship between such ties and survival chances as predicted by resource dependence (Pfeffer & Salancik, 1978) and institutional theory (Meyer & Rowan, 1977; Oliver, 1991). In the context on nonprofit organizations failure of young organizations is explained as a consequence of their lack of structural embeddedness, because ties to external actors are slow to build (Hager, Galaskiewicz, & Larson, 2004). Social capital and institutional ties of nonprofit organizations interact with the liability-of-newness effect in shaping the demographic evolution of the organizational population. Connections to political parties are found to buffer Finnish newspapers from environmental turbulences (Miner et al., 1990). Similarly, in the context of U.S. feature film producers the degree of connectivity and repeatedness of interactions with distributor organizations increase survival rates (Cattani et al., 2008).

An unexplored but potentially critical factor influencing firms' survival is the development of cooperative ties with organizations within the population. As it occurs for ties to external actors, these ties may provide firms with additional resources that improve performance. Evidence suggests that stable interorganizational networks increase access to resources which help reduce mortality rates (Brass, Galaskiewicz, Greve, & Tsai, 2004). Also, failure of a partner within a population was found to increase mortality rates (Singh & Mitchell, 1996). This result suggests that stable cooperative ties have an effect in enhancing survival chances. In my setting, cooperation between two railway companies is likely to increase the traffic volume of both companies, as it facilitates the access of passengers and goods to a higher number of locations. Therefore, increased traffic improves financial performance and is expected to reduce the probability of failure.

Nevertheless, depending on firms' initial resource base and on the resources they gain through their partners, cooperative ties may have different effects on organizational survival. This is consistent with the result that environmental shocks can cause increased or reduced failure rates for organizations with collaborative relationships depending on the types of relationships that they build (Mitchell & Singh, 1996). While cooperative ties within a form are likely to be aimed at benefiting from economies of scale (in the case of generalists) or reinforcing legitimacy by strengthening the perception of the form identity (mostly for specialists), cooperative ties across forms are more likely to be driven by the necessity to span different areas of the resource space in order to avoid competitive pressures (Dobrev & Kim, 2006). Because generalists operate in a richer resource area than specialists, they have broader exchange possibilities previous to establishing connections (Lomi & Pattison, 2006). In order to gain access to resources, specialists have more incentives to engage in cooperative ties with generalists than the opposite. This in turn gives generalists greater bargaining power in choosing their partners.

Another consequence of cooperative ties between organizations of a different form is that they require investments outside their initial niche position (i.e., inside or near the center for specialists cooperating with generalists, in the peripheral zones of the resource space for generalists connecting to specialists). This is a risky strategy because organizations that leave their original positions are likely to experience increased selection pressures (Dobrev, 2007; Dobrev, Kim, & Hannan, 2001).

In order to account for the complex relationships between ties, organizational form and survival, I develop four hypotheses that describe the set of possibilities of cooperation within and across forms: generalists can establish cooperative ties with generalists or specialists, and specialists can cooperate with other specialists or with generalists.

Cooperative ties between generalists

Many ecological studies have divided organizational populations by the region of the resource space (i.e., center or periphery) in which organizations operate, and by their niche-width, defined as the set of social opportunities and constraints that are linked to the organization's location in the resource space (Dobrev et al., 2001; Freeman & Hannan, 1983). The basic niche-width model distinguishes between two possible forms: generalists, which draw on a wide niche and possess slack capacity, and specialists with a narrow niche and limited resources in reserve.

Generalists target the "average" customer located at the center of the market (Boone, van Witteloostuijn, & Carroll, 2002), because such positioning allows them to cover a large amount of the potential demand. The center of the market thus becomes a crowded spot of the resource space as all the generalists aim for the same central position (Carroll, 1985). Consequently, prior to cooperative ties, niche overlap between generalists is maximal at the center, and localized competition takes its highest value, resulting in increased chances of mortality.

In such conditions, generalists establish cooperative ties with each other to reduce the intensity of the competition by agreeing on mutual forbearance (Baum & Korn, 1996, 1999). Because fierce competition for the center of the market is difficult to sustain and threatens the survival of generalists, cooperation is an adequate strategy for organizations that are less able to drive all their competitors out of the market, and alliances improve the survival chances of both network partners. This strategy has been extensively observed in studies of airline alliances, where code-sharing agreements have allowed access to the resources and information of partners (Gimeno, 2004). They have also led to cooperative pricing – and reduced fares in most cases – and increased traffic on the lines on which code-sharing agreements existed (Brueckner, 2001; Oum, Park, Kim, & Yu, 2004; Wang, Evans, & Turner, 2004). Furthermore, because generalists in the center of the market draw on economies of scale (Boone & van Witteloostuijn, 2004; Carroll, 1985; Van Witteloostuijn & Boone, 2006) partnerships between generalists allow them to increase their scale of operations, thus reducing their costs and increasing their financial performance, which also improves long-term survival possibilities. As a consequence, I expect the following relationship:

H1: Cooperative ties between generalists reduce their mortality rates.

Cooperative ties between specialists:

Specialists occupy specific niches which, although narrow, fit better the tastes of a group of customers than the standard products or services provided by the generalists (Carroll, 1985). Specialists are often found to successfully target untapped niches in industries traditionally dominated by large generalists benefiting from economies of scale: it is the case of microbreweries (Carroll & Swaminathan, 1992, 2000), farm wineries (Swaminathan, 2001) or point-to-point airline carriers (Seidel, 1997). The identity of specialists has been highlighted as a determinant cause of their success: they are characterized by authenticity, i.e. commitment to their clientele (Baron, 2004) and their strength lies in their ability to defend their identity and to market their products or services as more beneficial to the customers than those of generalists. This identity is often related to specific production modes and/or a strong regional identity (e.g. Carroll & Swaminathan, 2000). Because of the influence of specialists' form identity on their survival, and on the impact of collective action on the creation of this identity, specialists act together in a way that is similar to social movements in order to increase each other's legitimacy (Hannan, Pólos, & Carroll, 2007; Swaminathan, 2001).

Collaborative relationships between specialists speed the legitimation process: partnerships are likely to reduce the violations to the form identity by increasing the control operated by peers and enabling fast retaliation against deviating organizations. Thus, they further reinforce their collective identity. Cooperative ties can also reduce the cost of marketing operations aimed at increasing audience awareness of the form identity by creating economies of scale in these operations, thus easing the acquisition of legitimacy (Hannan et al., 2007; Zuckerman, 1999). As a consequence, the magnitude of the legitimation effect that specialists have on each other, which improves survival chances, is likely to be larger when they engage in cooperative dyadic ties. These arguments lead to the following hypotheses:

H2: Cooperative ties between specialists reduce their mortality rates.

Cooperative ties across organizational forms:

Generalists connecting with specialists located in the periphery can gain position in niches that are located outside the market center and whose demand was previously covered by specialists only. They attempt to do so when the competitive pressure in the center of the market becomes too high and when they are not able to build an identity that is robust enough to operate simultaneously in the center and the periphery (Swaminathan, 2001), usually because the cost of offering products that are similar to those of specialists are too high (i.e., when segregating processes between generalists and specialists are strong). Segregating processes are strong when the technical requirements for operating in the center or in the periphery of the resource space are very different, as it occurs in the brewery industry (Carroll & Swaminathan, 2000), or when the fixed costs of entering into a new market area are high, as it occurs in industries requiring important investments in operating infrastructures, such as airline carriers or railroads.

When segregating processes exist, connections between generalists and specialists drive generalists away from the center of the market and lead them to locate in a near-center position. An organization occupies a near-center position if “it has a position of peak appeal that lies outside the market center but its fundamental niche intersects a market center." (Hannan et al., 2007, p. 217). Near-center positions are extremely difficult to maintain, because the competitive pressure in the center of the market partially affects near-center organizations, but at the same time they are driven away from the area that is richer in resources (Hannan et al., 2007) because they need to devote a significant amount of resources to their relationship with peripheral organizations, where resources are scarcer than in the center. Furthermore, organizations located in the near-center suffer from the impact of a double "violation by comparison" (Dobrev, Ozdemir, & Teo, 2006) with generalists that stay in the center and specialists with a strong identity. As a consequence, while moving to the near-center of the market can be a successful strategy for the few organizations that occupy first the richer niches located in this area, most of the generalists moving to a near-center position by connecting to a specialist will fail as the result of intense competition, scarcer resources and an unstable identity. Moreover, the effect of violation by comparison will be to reinforce the identity of generalists that are not connected with specialists and increase their survival chances: by contrast, the mortality rates of generalists that engage in cooperative ties with specialists will increase (with respect to mortality without these ties).

H3: Cooperative ties between generalists and specialists increase the mortality of generalists.

For specialists, the incentive to develop network connections with generalists comes from the increase in exchange possibilities that such connections enable (Lomi & Pattison, 2006). Cooperative ties improve specialists' fit in conditions that would otherwise only benefit generalists, such as environmental variability (Freeman & Hannan, 1983), by allowing them to access fine-grained information on the changing requirements of the market and ensuring access to a larger range of relevant resources (Gulati, 1998; Uzzi, 1996). Thus, enduring cooperative ties with generalists, which possess more resources and information, have a larger positive impact on financial performance for specialists than for other generalists (Echols & Tsai, 2005). Since financial performance positively affects survival chances, and consistent with the existence of positive interdependences in survival rates between connected generalists and specialists that has been observed in studies of early telephone companies (Barnett & Carroll, 1987, 1993), I predict that:

H4a: Cooperative ties between specialists and generalists reduce the mortality of specialists.

However, the social ledger model (Labianca & Brass, 2006) shows that embeddedness in a network can create liabilities when negative information is conveyed through the network. I know that specialists' survival is hindered when they choose strategies that are associated with a generalist form and thus violates the identity characteristics of specialist organizations. In the U.S. wine industry where the competitive advantage of farm wineries, i.e. specialists, lies in offering estate-bottled wines produced in small quantities and perceived as high-quality products, as opposed to the wines of mass producers, the failure rates of farm wineries increase when they increase the scale of their operations because the adoption of features that consumers associate with lower-quality wines is detrimental to specialists (Swaminathan, 2001).

Because an organization's identity is partly determined by its affiliation (Blau, 1964; Podolny, 2005) and because compliance with the norms linked to their identity is crucial for specialists, the choice of partners will have a strong impact on specialists' legitimacy. The negative effect for specialists of cooperating with specialists is particularly important because claims to authenticity by specialists are often maintained through a discursive confrontation with generalists and the opposition of two schemata (Hannan et al., 2007). Thus, because generalists are often stigmatized among specialists and their audience, engaging in a cooperative tie with a generalist is likely to harm the perception of authenticity of the connected specialist among audience members (Pontikes, Negro, & Rao, 2008). The blurring of identity that derives from cooperative ties between generalists and specialists would then negatively affect their survival chances. These arguments imply that:

H4b: Cooperative ties between specialists and generalists increase the mortality of specialists.

Hypotheses H4a and H4b imply that there could be two effects acting in opposite directions in shaping the mortality rates of specialist organizations that engage in cooperative ties with generalists. The model that results from my hypotheses is presented in Figure 4.

My theoretical model predicts that cooperative ties within forms increase survival chances, but the underlying mechanisms that lead to these hypotheses are different: while hypothesis 1 is derived from a decrease in competitive intensity between connected generalists, hypothesis 2 reflects an increased legitimacy for connected specialists. The effect of cooperative ties across organizational forms is more ambiguous: in the case of generalists, cooperation with a different form are predicted to increase mortality, but there could be asymmetries in the relation, since the effect of cooperation on specialists' mortality could be negative if H4a is verified or positive (in which case the relationship will affect similarly both forms) if H4b is verified.

Figure 4: Theoretical model linking organizational form, cooperative ties and mortality rates in organizational populations

	Cooperative tie to a generalist	Cooperative tie to a specialist
Generalist	**H1:** *Reduced mortality*	**H3:** *Increased mortality*
Specialist	**H4a and H4b:** *Undetermined*	**H2:** *Reduced mortality*

METHODS

Dyadic ties in the Spanish railway industry, 1848-1935

In the railway industry, dyadic ties between organizations are easy to track because competition and cooperation are determined by the geographical location of the companies. Also, because of the regulation of the sector and the relevance of railways for the economic and social life of a region, the opening or closing of a new railroad are highly salient events and receive intense coverage. Cooperation agreements require a long-term commitment to the partnership because the infrastructures needed to cooperate are substantial.

The Spanish railway industry operated under competitive conditions from 1848, date of the opening of the first railroad in the country, to the summer of 1936. After this period, railroads were either stalled or destroyed by the Spanish

Civil War, and when the war ended in 1939, Franco's dictatorship decided to nationalize most of the companies and to group them into a State-owned company that still exist nowadays, RENFE.

The first Spanish railroads were built before any railway legislation was passed: although many European countries had a consolidated railroad system by 1848 when the first railroad opened in Spain, railway development was not a priority for the conservative government (from the *Partido moderado*) in office from 1843 to 1854. Thus, there were already 8 companies operating in the railway industry when the first Railways Law was passed in 1855 by the liberal government (*Partido progresista*). However, a conservative coup brought the former government back in place in 1856, and the railway legislation was never enforced (Artola, 1978): although the Railways Law determined that all railroads ought to have the same gauge (the Spanish standard, defined by Spanish civil engineers in 1844, which was different from the European standard), it did not keep most railway companies from overlooking this requirement constructing railroads of different gauges even after the law was passed. As a consequence of this loose regulation and following a similar path as the early British railway industry (Wolmar, 2007), the Spanish railway industry was submitted to less control than that of nearby countries such as Portugal or France regarding the opening of new railroads and the creation of new companies, in particular as far as checks on financial viability of the projects were concerned (Dobbin, 1997).

During the period of this study, the rights to build and exploit railroads were assigned by the government through a downward auction mechanism. The company that presented the least costly project and required the smallest subsidy was granted the right to build a railroad and a 99-year concession for its exploitation. Competitors did not have the right to build a track serving the same itinerary but they could serve the same stations indirectly. For example, only one company had a direct railroad from Madrid to Zaragoza, but another company offered the possibility to go from Madrid to Zaragoza through Valladolid and Burgos. When two companies served the same city, they could decide to connect their tracks and share a station or to locate in different stations and operate independently from each other.

Formal cooperation agreements were required when two companies shared a station and had connected tracks, as they needed to coordinate on schedules in order to avoid accidents, on costs derived from the use of the station, and on fares, in particular when clients were requiring transportation from a station belonging to one of the network partners to a final destination served by the other partner and transited by the shared station. In this setting, even when two railway companies served two of the same cities and shared stations in both places, they could not be considered as competing for passengers and freight traveling from and to these stations: although they had different ticket offices, the companies used the same buildings, could provide better services (such as restaurants or luggage delivery) because they shared the costs of the buildings and operations, while companies operating on their own often owned a very small station offering only basic services (Tedde de Lorca, 1978). Partner companies operated jointly all the services and had agreements to charge passengers the same fares. These agreements were very similar to those observed in airline code-sharing agreements, in which two companies appear to compete by selling tickets for separate flights serving the same routes, but establish agreements to jointly operate on these routes and avoid competing with each other (Ito & Lee, 2007).

When two companies operated from the same city but did not engage in formal cooperation, competition between them was more intense, not only when they served the same cities, but also when they offered different roads of potentially similar characteristics. Similarly to what has happened in the last decade with low-cost airlines (Shaw & Thomas, 2006), the availability of flights to once-remote locations increased the overall demand for flights. Competition between railroads operating from the same city and serving different destinations was especially relevant in the case of freight transportation: industrial firms operating in a given geographical location were looking for railroads serving large cities or ports to supply their products to customers outside their region or even abroad, but holding prices constant, they had little preferences regarding the port from which their goods were traveling to European countries (Artola, 1978). The fact that railways in situations of monopoly on specific destinations often lowered their fares to resist competition from other railroads serving different geographic points provides evidence regarding this competitive situation (Pascual Domènech, 1999).

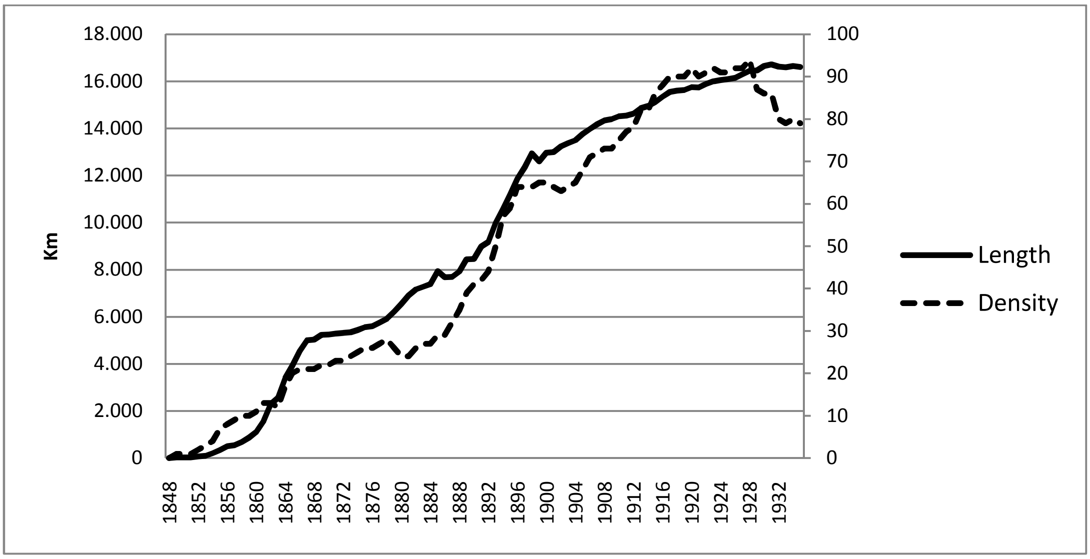
The decision to cooperate was not positively related to the distance over which companies were in contact: when two companies served the same cities, some decided to share stations, but in other cases, they built tracks that operated parallel to each other over miles. The most extreme case occurred in the Valencia area (Eastern Spain) where two companies had parallel tracks for 184 km (Vía-Libre, 1993).

Thus, in the Spanish railway context, I can consider that organizations that shared a station were involved in direct cooperation, while organizations that did not share any station but operated from the same stations were directly competing. Organizations that did not locate in the same geographic area only had a diffuse impact on each other.

Data

I used an original database including the 146 railway companies that operated in Spain at some point during the period 1848-1935. The number of railway companies operating in Spain varied between 1 in 1848 and its maximum number of 94 in 1928 and the network length reached 16.615 km at the end of my time frame. The evolution of the density of railway companies and the total railroad length over this period are represented in Figure 5.

Figure 5: Total railroad growth in length and density in Spain, 1848-1935



I reconstructed the life histories of all the companies operating during this period from annual directories of the sector created by Enrique de la Torre (La Torre, 1893-1935), an engineer employed at the largest railway company. For years previous to 1893 I gathered information from the two weekly journals of the industry, the *Gaceta de los Caminos de Hierro* and the *Revista de los Caminos de Hierro*. The reliability of the data used to build the census was cross-checked using two additional sources, on the opening on railroad sections since 1848 (García Raya, 2006) and a book on narrow-gauge railways (Muñoz Rubio, 2006), both based on primary archival data.

All of the companies in the Spanish railway population transported passengers (although 2 companies in my dataset operated for a few years with freight only before including passenger service) and most transported freight as well, with the exception of some short-distance suburban companies that were dedicated to passenger transportation only.

Variables

In my model, I distinguished between generalists and specialists based on the roads they operated and whether these roads were designed to attract the average customer. Data on the economic activity or population in the different provinces of Spain is only available for the last years of my study. Since the railway industry had an important impact on the development of the regions in which railroads were implanted (Gómez Mendoza, 1982; Tortella Casares, 1995), it is very difficult to make inferences on the population or GDP data for the first years of my period of analysis without upward biasing the series for the regions that benefited from the early implantation of railway service.

Furthermore, I need a more fine-grained measure than data at the provincial level, since all railroads going through the richest provinces are not necessarily the ones focusing on the average customers: railroads serving an industrial area or a thermal city in the Barcelona region have a very different distance with respect to the peak of the resource distribution.

In order to avoid the problems that could be created by relying on data collected at the regional level and retrospective analysis, I created my *generalist/specialist* variable for each railroad company by relying on reports that were written contemporaneously to railway development in Spain. Here, I could approximate the location of the peaks of the resource distribution by looking at the roads whose construction was included in listings of railroads of high national priority, as defined by the Spanish Railway Commission, formed by engineers and members of the parliament. The priority plans defined by this Commission were described in Artola (1978). The roads that were considered of high priority were those connecting two or more large cities or important economic centers such as ports. For example, railroads between Madrid and all major cities (Barcelona, Zaragoza or Valencia) or important ports like Bilbao or Cadiz were all included among the lines that were of high priority for the Railway Commission. Because of the economic importance of these axes, the potential demand for these railroads was much higher that the demand for railroads serving points without these characteristics. However, the priority plans did not imply that the railroads included in them were built first or got more subsidies. In the first years of the industry many roads were proposed to auction before the ones that were included in the priority plans because of corruption or personal interests of the politicians that organized the auction process, and some of the roads that were in such plans did not get built in years after their assignation because intense speculation made the shares of the company worth more than actually building the roads or because of economic crises or difficulties to get funding in a incipient banking system (Artola, 1978; Veiga Alonso, 1999).

Many of the specialist railroads were created with support from provincial and local governments, after a strong political opposition to the plans proposed by the Spanish Railway Commission. Regions that were not included in these plans protested against the increase in regional inequalities that railroads were likely to cause if the roads were only built between cities displaying an important economic activity, and they actively promoted regional railroads and funded them by giving land for their building (Artola, 1978). The arguments that were raised at that time against the priority plans show the validity of my reasoning considering railroads included in these plans as generalists targeting the center of the market, while railroads that were not part of these plans remained in the periphery. These specialist railroads generally served smaller cities and contributed to the economic development of peripheral regions, and most of them operated in only one or a few provinces.

Some of my theoretical arguments on generalists and specialists are based on the existence of different identities for the two organizational forms. The idea that railroads excluded from the priority plans became an organizational form with a strong identity is reflected in the fact by most of these organizations included “Ferrocarriles secundarios” (Secondary Railways) in their names, and the fact that the Parliament approved a specific law on secondary railways in

1904 (and three more in the following fifteen years) shows the consensus on the specificity of that organizational form.

The information extracted from the Railway Commission reports was at the railroad-level, and I distinguished between generalists and specialists by aggregating information on all the railroads operated by each company. Thus, a generalist is an organization that possesses at least a railroad that is included in the priority plans, while a specialist does not operate any of those, either because it serves only small cities or because it connects a large city to small ones: examples of those are trains connecting Madrid or Barcelona to surrounding recreation places and operating mostly on Sundays. Generalists defined in that way operated more numerous and more lengthy roads than specialists: generalists operated on average 4.4 roads for an average length of 569.3 km served, while the average number of roads for specialists was 1.1, with an average length of 51.5 km. Figure 3 (p.26 in Chapter 2) shows the evolution of densities by organizational form from 1848 to 1935.

I then included in my model four dummy variables, indicating the existence of connections from a *generalist to a generalist*, from a *generalist to a specialist*, from a *specialist to a specialist* and from a *specialist to a specialist*. As mentioned in the introduction, cooperative ties exist between railway companies that agree on operating from the same station and coordinating on schedules, fares and use of tracks, while direct competition (included as a control variable) is observed when two railway companies operate from the same city but from different stations. When two organizations operated from the same city, they chose to cooperate in approximately 59% of the cases, and to compete in about 41% of them.

I used a dummy variable because the number of connections was equal to 0 or 1 for a majority of organizations, as it appears in Figure 2 (p.24 in Chapter 2). Furthermore, the total number of connections was more correlated than the dummy variable to the organization's size and to total density, which increase the opportunities of finding network partners.

Controls

In line with most previous ecological studies, I included a series of environmental and organizational control variables. Organizational size was measured by the logarithm of the total number of *passengers* that used the company's roads each year, and organizational *age* was measured by the logarithm of the time (in years) since the opening of a company's first railroad. I took into account the date of opening because many of the railroads that were assigned through auctions never got built, or the companies that owned the rights for its exploitation sold it before the opening, either once the railroad was built or during its construction, so that I could not use the concession date as an indicator of operation in the railway industry.

I also controlled for the existence of non-cooperative dyadic ties with other companies for each organization, by indicating whether they were operating from cities in which different railway companies competed for customers and did not cooperate. I indicated the existence of direct competition by a dummy variable taking the value of 1 when a railway company operated from a city in which at least another company was present and did not cooperate with the focal firm and 0 otherwise. Similarly to what I do for cooperative dyadic ties, I use a dummy variable because in over 67% of the cases, railway companies had either zero or one direct competitor. However, using the count of direct competitors did not substantially modify my results.

Among the environmental variables, I controlled for the effect of crowding and legitimation effects in the population, measured through population *density* in any given year. In some of the models I used *form density* instead of total density in order to account for the fact that legitimation and competition effects seemed to be more intense within a form than across forms (see for example, Dobrev et al., 2006; Kuilman & Li, 2009).

I also included an indicator of the economic activity in the country (Carroll & Delacroix, 1982), the logarithm of the Gross Domestic Product in millions of pesetas (the Spanish currency at that time). This series was taken from Carreras and Tafunell (2005) and was expressed in constant currency with respect to the GDP of year 1995.

Model

I treated as failures the cases in which an organization ran out of business or was acquired by the state, while exits due to acquisition by a competitor were treated as right-censored. The decision to consider acquisition by the State as failures was consistent with discussions of the role of the State in the railway industry (Artola, 1978) which took control of some railroads whose existence was important for the citizens, but were not profitable, and gradually increased its intervention in the railway industry, ending with the nationalization of most of the companies after the Civil War (Ortuñez, 2004).

I then evaluated the probability of failure through a Cox proportional-hazard model of the form: $h(t) = h_0(t)e^{\beta_1 x_1 + \ldots + \beta_k x_k}$, where h_0 is the baseline hazard rate and the x's are the covariates.

I estimated four different models: the first two models were baseline models, with only the control variables as covariates explaining failure rates, while the two last models included the four connection variables.

RESULTS

The population of Spanish railway companies was formed of 146 organizations, 23 of which failed over the 1848-1935 period while 36 more disappeared through acquisition.

The means, standard deviations, minimum, maximum and correlations among the variables used in my models are shown in Table 3.

Table 3: Descriptive statistics and correlation matrix

	Mean	**S.D.**	**Min**	**Max**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Age (log)	2.70	0.95	0.00	4.42	1.00									
2. Form density	43.92	24.00	1.00	74.00	0.21 (0.00)	1.00								
3. Total density	68.13	24.23	1.00	94.00	0.44 (0.00)	1.00								
4. Generalist connected to a generalist	0.25	0.43	0.00	1.00	0.14 (0.00)	-0.66 (0.00)	-0.12 (0.00)	1.00						
5. Generalist connected to a specialist	0.13	0.34	0.00	1.00	0.18 (0.00)	-0.45 (0.00)	-0.05 (0.00)	0.64 (0.00)	1.00					
6. Specialist connected to a generalist	0.45	0.50	0.00	1.00	-0.02 (0.22)	0.49 (0.00)	0.23 (0.00)	-0.51 (0.00)	-0.35 (0.00)	1.00				
7. Specialist connected to a specialist	0.20	0.40	0.00	1.00	0.09 (0.00)	0.34 (0.00)	0.19 (0.00)	-0.29 (0.00)	-0.20 (0.00)	0.17 (0.00)	1.00			
8. Passengers (log)	12.32	1.93	0.00	17.23	0.24 (0.00)	-0.14 (0.00)	0.05 (0.00)	0.30 (0.00)	0.39 (0.00)	-0.18 (0.00)	0.07 (0.00)	1.00		
9. GDP (Log)	15.48	0.33	14.59	15.98	0.46 (0.00)	0.66 (0.00)	0.88 (0.00)	-0.12 (0.00)	-0.04 (0.01)	0.22 (0.00)	0.19 (0.00)	0.05 (0.00)	1.00	
10. Direct competition	0.47	0.50	0.00	1.00	0.14 (0.00)	-0.01 (0.74)	0.04 (0.00)	0.06 (0.00)	0.17 (0.00)	-0.38 (0.00)	0.04 (0.00)	0.34 (0.00)	0.05 (0.00)	1.00

The percentage of organizations that are connected to a competitor is 25% for generalists connected to generalists, 13% for generalists connected to specialists, 45% for specialists connected to generalists and 20% for specialists connected to specialists.

Table 4: Estimates for the Cox proportional hazard model of mortality rates in the Spanish railway industry (1848-1935)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Age (Log)	0.77** (0.31)	0.79*** (0.33)	0.96*** (0.34)	0.94*** (0.34)
Form density	-0.01 (0.01)		-0.01 (0.02)	
Total density		0.29*** (0.08)		0.26*** (0.08)
Generalist connected to a generalist			-2.30** (1.11)	-1.98* (1.02)
Generalist connected to a specialist			2.17** (1.01)	2.18** (1.02)
Specialist connected to a generalist			-0.67 (0.61)	-0.68 (0.60)
Specialist connected to a specialist			-2.24** (1.03)	-2.24** (1.02)
Passengers (Log)	-0.21*** (0.08)	-0.19*** (0.08)	-0.20** (0.08)	-0.20** (0.08)
GDP (Log)	-24.58*** (8.94)	-36.73*** (10.18)	-22.55** (9.05)	-33.52*** (9.88)
Direct competition	-0.44 (0.43)	-0.47 (0.43)	-0.96** (0.48)	-0.96** (0.49)
Number of subjects	146	146	146	146
Number of failures	23	23	23	23
Log-pseudolikelihood	-95.67	-95.97	-88.19	-88.18
Wald Chi2	23.28***	27.09***	32.39***	36.96***

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results are presented in Table 4. The proportional hazards assumption was tested using the robust variance-covariance matrix and was supported in the four models. Model 1 and 2 are the baseline models for organizational mortality. In Model 1, I consider for each form the density of similar organizations as the determinant of organizational failure, while in model 2, I use total organizational density as a variable explaining railway companies' failure rates. Form density does not significantly affect failure rates, while total density significantly increases mortality, but model 1 provides a slightly better fit than model 2 (Log-pseudolikelihood = -95.67 for model 1 and -95.97 for model 2). In models 3 and 4, I introduce the cooperative ties variables together with the form density and total density variables in order to test my hypotheses and this significantly increases the fit of my models.

Hypothesis 1, which states that connections between generalists reduce their mortality, is supported in models 3 and 4. The effect is more significant in the model using the form density ($p<0.05$) than in the model using the total density variable, where it is only marginally significant ($p<0.10$). The hypothesis stating that connections between specialists reduce their mortality rates is also supported in models 3 and 4. In both cases, I find a negative coefficient with high statistical significance ($p<0.05$).

The hypothesis that cooperative ties between generalists and specialists increase the mortality of specialists, hypothesis 3, is also supported. In models 3 and 4, the "generalist connected to a specialist" variable displays a statistically significant ($p<0.05$) positive coefficient. However, H4a and H4b fail to be supported: connections between generalists and specialists have a negative but non-significant effect on the mortality of specialists.

The fact that neither H4a nor H4b are supported could actually indicate that both hypotheses are simultaneously supported, and the non significant negative sign could show that the magnitude of the effect predicted by H4a, i.e. reduced mortality, is slightly larger than that of H4b, which predicts that specialists cooperating with generalists will experience higher mortality. This would show that the increased financial performance of specialists affects their long-term survival more positively than the blurring of identity harms survival chances. Nonetheless, since I cannot disentangle the two effects and I find no significant relationship between cooperative ties of a specialist to a generalist, I cannot assess these effects more precisely.

My results also show that mortality rates increase with organizational age. This is consistent with the “liability-of-adolescence” proposed by Brüderl and Schussler (1990) for firms with an important initial resource endowment – which is the case for railway companies, starting with large fixed assets – and supported by other empirical findings (Fichman & Levinthal, 1991; Henderson, 1999). I also find a negative effect of size, measured by the number of passengers, on mortality rates, a result that has been found in many ecological studies (see Carroll & Hannan, 2000, for a summary). Economic prosperity also relates positively to survival, as the negative sign associated with GDP in mortality models 1 to 4 shows. The fact that the coefficient is larger and has more statistical significance in models 2 and 4, i.e. when associated with total density, can be explained by the correlation between total density and GDP. This correlation is due to the high economic impact that the development of the railway industries had on economic growth over the late 19th and early 20th centuries, as the railway sectors grew larger (e.g., Foreman-Peck, 2003; Hawke, 1970).

Total density significantly increases mortality rates: when there is crowding in the Spanish railway population, failure rates increase in models 2 and 4. However, the effect of form density on failure rates is not significant, neither in the baseline model (model 1) nor in the model including the connection variables (model 3)[4]. This could indicate that in the early railway industry, legitimation and competition processes were not only operating within forms but also outside the boundaries of a single organizational form and that it is necessary to account for the pressures created by other organizations in the population.

The direct competition variable is not significant in the baseline models (models 1 and 2), when the connection variables are omitted. This result is not surprising since I only account for competitive contacts in these models. Since many organizations had competitive and cooperative market contacts with different – and in some instances, with the same – organizations, restricting the measure of market contacts to competitive contacts increases the errors and reduces the statistical significance of the effect. However, the direct competition variable maintains its negative sign but becomes significant in models 3 and 4, when I include the connection variables. This effect is consistent with the literature on interfirm rivalry (Baum & Korn, 1996) which shows that direct competition increases mutual forbearance.

DISCUSSION

The setting of the Spanish railway population allows for a straightforward measurement of competitive and cooperative market contacts between all operating firms. In this study, after controlling for the effects of population

[4] Including the quadratic terms for total density and form density did not change these results.

density and competitive ties between organizations, I find that different types of ties create different benefits and liabilities for the connected companies. In particular, I find that cooperative ties between organizations of the same form increase their survival chances, while cooperative ties between organizations of different forms do not: cooperative ties between generalists and specialists increase the mortality of generalists, and do not significantly reduce mortality rates for specialists.

These findings show the importance of disentangling the effect of connections on organizational mortality for different forms and different types of connections. While many studies aggregating connections of different types have found that they decrease mortality, I show that a more fine-grained classification of connections, by the type of organizations to which they connect, partly contradicts this picture. In some instances, there is a liability of connectedness: generalists connecting to specialists experience a significant rise in their probability of failure. I also find that some ties can have an asymmetric effect on both partners: connections between generalists and specialists increase the mortality for the generalist, and do not have such effect for the specialist partner. This asymmetry shows that it is important to consider carefully the properties of different network ties in assessing their role on mortality or other types of performance outcomes.

The finding that connections between generalists have a negative effect on their mortality rates shows that partnerships that allow partners to benefit from economies of scale and that favor mutual forbearance at the center of the market are beneficial. The negative effect of connections between specialists on their mortality rates, however, is likely to be mainly due to a legitimation effect and not to a moderation in the intensity of competition. Specialists tend to occupy specific niches and, especially in the Spanish railway context, do not significantly overlap with each other. As a consequence, strategies aimed at mitigating competition from other specialists make little sense and have a small impact on survival chances, while the legitimation effects that they have on each other can spread over larger geographic areas, as reported in previous studies (Bigelow, Carroll, Seidel, & Tsai, 1997).

The result that connections between generalists and specialists increase their failure rates, shows the increased mortality experienced by organizations that locate in a near-center position (Hannan et al., 2007). This effect relates to the increased mortality experienced by middle-sized organizations as described by Meyer (1990) in the following terms: “large organizations capture the advantages of generalism and small organizations the advantages of specialism, leaving organizations in the middle range of size with the liabilities of both” (p.304). I believe that this is the situation experienced by near-center organizations, but that this effect does not depend on their size, but rather on their location in the resource space and the advantages and liabilities associated with this location.

I need further research to disentangle the effects of connections between generalists and specialists on specialists’ mortality. It is likely that the positive effect on financial performance and the negative effect on identity that these connections create simultaneously determine mortality rates, and I also know that financial performance increases survival chances. I provide some preliminary evidence on the importance to evaluate trade-offs between different performance outcomes, survival and financial returns, when building networks of interorganizational cooperation. This is similar to the result that structural holes in networks exert simultaneous and opposite influences on different performance outcomes, which in turn interact with each other (Shipilov & Li, 2008). However, I believe that the finding that connections between generalists and specialists have an asymmetric effect on the mortality of the two forms is important.

This study presents a number of limitations. Firstly, connections between two organizations were measured in my database as a binary variable taking value 0 or 1 (if the organizations are connected). Thus, my model only accounts for the existence of connections, but not for their intensity. A second limitation comes from the difficulty to generalize the measures of dyadic ties to other settings. While I chose this industry because the measurement of cooperative and dyadic ties was straightforward in the railway setting, I acknowledge that the replication of this study in other settings may be difficult. Finally, I could not account for differences in regulation over the period of study: historical accounts of the creation of the Spanish railway industry are consistent in showing that the differences between the formal legal system and the rules that actually applied to railways were extremely important, because of the endemic corruption in Spain during these years. Indeed, I conducted a series of tests that show no effect of railway policy on mortality rates in the Spanish context, as opposed to the results observed in the U.S. railroad industry (Dobbin & Dowd, 1997, 2000)

CONCLUSION

This study contributes to research in strategy by measuring the effect of cooperative relationships on mortality rates in an organizational population.

While most studies tend to consider that external relationships enhance firms' access to resources and performance, I have shown that external relationships are not always effective as a buffer from environmental uncertainties, and that there exists a liability of connectedness under certain conditions. I also find that when ties are created between organizations of a different form, they have an asymmetrical effect on the organizations that are involved. These results have important implications for strategy theorists and practitioners, as they lead to reformulate the claim that network ties are a good mechanism to deal with environmental uncertainty (e.g., Pfeffer & Salancik, 1978) and creates mutualism that leads to enhanced survival chances (Barnett & Carroll, 1987): my results suggest that it is not always the case, and that the risks of involvement into an interorganizational cooperative network in terms of financial performance and of survival need to be carefully assessed.

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Chapter 4 - Exploring the link between coopetitive strategies, industry structure and firm performance

The existence of complex relationships between firms that get simultaneously involved in cooperation and competition with each other has been recently acknowledged by strategy researchers and referred to as coopetition (Nalebuff & Brandenburger, 1996). While the first studies within the coopetition framework claimed that coopetitive strategies provided superior benefits with respect to purely competitive or cooperative strategies (e.g., Bengtsson & Kock, 2000; Nalebuff & Brandenburger, 1996) through a decreased intensity in competition and collusion (Greve & Mitsuhashi, 2004), very few empirical studies have tested the performance implications of coopetition (Luo, Rindfleisch, & Tse, 2007; Ritala, Hallikas, & Sissonen, 2008). Furthermore, while different types of coopetitive relationships have been identified depending on the intensity and balance of competition and cooperation within the relationship (Bengtsson & Kock, 1999, 2000; Ritala et al., 2008), the performance consequences that they entail have not yet been investigated.

In this paper, I examine the effects on financial performance of different coopetitive strategies, depending on whether they are dominated by coopetition or cooperation, and study how characteristics of the industry affect the benefits that can be derived from these strategies. I rely on a large dataset including all the relationships between organizations in the Spanish railway industry over nearly 90 years. The existence of network externalities that create positive interdependences between competitors in this industry makes the analysis of coopetitive strategies particularly relevant.

I contribute to the literatures in strategy and industrial dynamics by showing the performance implications of various mixes of cooperation and competition under different industry structures. My findings show that the effect of different coopetitive strategies on profitability depends on the crowding of the market: while competition-dominated strategies are in general more profitable than cooperation-dominated strategies, this difference decreases as population density increases. An additional contribution of this paper is that I examine the complete set of relationships between firms within an industry, while most studies on coopetition have focused on case studies or on a sample of large and successful firms. The data set used here brings us the opportunity to conduct a more extensive analysis of the consequences of coopetition at the industry level.

COOPETITIVE STRATEGIES AND FIRM PERFORMANCE

Coopetition has been described as a situation in which value is created through simultaneous management of cooperation and competition (Bengtsson & Kock, 2000; Nalebuff & Brandenburger, 1996). This framework was developed in order to highlight the potential benefits of cooperating with competitors (Nalebuff & Brandenburger, 1996).

Coopetition has been held responsible for a variety of beneficial outcomes such as added value and higher pricing (Dozoretz & Matanovich, 2002) or higher quality and productivity which increase profitability (Bucklin & Sengupta, 1993; Lado, Boyd, & Hanlon, 1997; Walley, 2007). However, while the drivers of coopetition between organizations have been discussed in a variety of studies (Gnyawali, He, & Madhavan, 2006; Luo, Shenkar, & Gurnani, 2008), very few have empirically examined its actual effects on performance (Luo *et al.*, 2007) or the possible downsides of coopetition (Afuah, 2000; Bonel, Pellizzari, & Rocco, 2008; Bonel & Rocco, 2007). Among these, only asymmetric learning and value appropriation between opportunistic partners in knowledge-related alliances have received important attention (Dussauge, Garrette, & Mitchell, 2000; Hamel, 1991; Hamel, Doz, & Prahalad, 1989; Khanna, Gulati, & Nohria, 1998; Mitchell, Dussauge, & Garrette, 2002).

One of the main issues in previous coopetition studies is the generalizability of their findings, for two major reasons. Firstly, empirical studies of coopetition have been based on a very small number of cases (Bengtsson & Kock, 1999, 2000; Bonel & Rocco, 2007) or on samples of large salient companies (Ritala *et al.*, 2008). In order to draw conclusions on the effect of coopetitive strategies on performance, I need to use a large number of cases representing the full set of firms operating in an industry. Secondly, the term coopetition encompasses a great variety of relationships but financial performance will differ depending on the intensity of cooperation and competition and the balance between them in a given relationship (Ritala *et al.*, 2008). Investigation of the social structure of coopetition and its effects on performance has been limited to a few studies of intra-organizational (Luo, Slotegraaf, & Pan, 2006; Tsai, 2002) or within-team (Beersma, Hollenbeck, Humphrey, Moon, Conlon, & Ilgen, 2003) relationships. It is important to distinguish between coopetitive strategies based on the intensity of cooperation and competition in order to show that differences in the type of strategy adopted lead to different performance implications.

The most obvious examples of the benefits of coopetition between independent organizations can be found in complementary industries such as cars and insurances, or microprocessors and software, but coopetition can also be an interesting strategy within a single industry. In particular, coopetitive strategies characterize markets that display network externalities, as in the railway industry (Fjeldstad, Becerra, & Narayanan, 2004). When there are network externalities between organizations operating in the same industry, it is necessary to consider cooperative strategies as coopetitive games where the partners cooperate on some aspects but compete on others (Padula & Dagnino, 2007). In the context of Spanish railways, firms cooperated in a specific location by sharing a station but they also competed inside the station for the same customers and companies. However, competition between companies also generated positive network externalities, because market demand increased with the size of the network as more destinations were becoming available for passengers.

In settings characterized by network externalities, where competition between firms can have a positive effect on the profitability of all the actors in the sector because it increases the attractiveness of the market, determining the relative importance of cooperation or competition in a relationship is particularly relevant. Distinguishing coopetitive strategies that are cooperation-dominated or competition-dominated (Bengtsson & Kock, 2000) allows determining the conditions under which coopetition is beneficial. Competing on some activities while cooperating on others has been shown to be the most beneficial strategy in logistic relationships (Klein, Rai, & Straub, 2007) but the ideal balance of cooperation and competition is likely to depend on the characteristics of the industry.

In the presence of network externalities, it may be the case that in early stages, strategies aimed at expanding the network and tapping structural holes while they exist are more profitable (Zaheer & Bell, 2005). Competitive moves also lead to increased performance when they are made at early stages of the industry and influence the technological standard (Arthur, 1989; Leiponen, 2008) but moves aimed at setting standards become less likely once the network has reached its critical mass (Economides, 1996).

When market penetration is low, having loose relationships with partners can provide advantages: while both partners expand their area of operations independently, they do not fully commit to each other and maintain bargaining power because they can withdraw from the relationship if it is not profitable and influence the evolution of the network before it becomes stable. This strategy is important in order to search for new partners when there are few available firms, especially in early stages when there is no information on the reputation of new actors. Loose relationships allow partners to gain information on the trustworthiness of the other part.

Furthermore, when the market becomes crowded, the objective changes from attracting new customers to getting more profit from existing customers. As the sector grows at lower rates, competition between actors becomes more aggressive (Ferrier, 2001) and hypercompetition makes competitive advantages harder to sustain (Schumpeter, 1942; Wiggins & Ruefli, 2005). Under these conditions, coopetitive strategies that are dominated by competition are difficult to maintain: firms will not accept aggressive competitive moves from their partners and will be less willing to cooperate unless they perceive a full commitment from their allies. As a consequence, the benefits of competition-dominated strategies decrease as the market becomes more crowded.

This leads to the following hypothesis:

H1: Coopetitive strategies that are dominated by competition are more profitable when market penetration is low than when the market is crowded.

When market penetration is higher, the overall network becomes more stable and cooperation is important because it allows for an increase of profit margins through an intensification of transaction and capacity utilization (Fjeldstad *et al.*, 2004) and a reduction of the average cost through economies of scale. When density gets higher, more information can flow between partners, and the quality of the information exchanged will be higher between partners engaged in tighter relationships. Furthermore, strategies that are dominated by cooperation can be a buffer against the surrounding competitive aggressiveness. As a consequence, I expect that:

H2: Coopetitive strategies that are dominated by cooperation are more profitable when the market is crowded than when market penetration is low.

SETTING

In the railway industry, competition and cooperation strategies between organizations are easy to track: because of the regulation of the sector and the relevance of railways for the economic and social life of a region, the opening or closing of a new railroad are highly salient events and receive intense coverage.

Cooperation agreements require a long-term commitment to the partnership because the infrastructures needed to cooperate are substantial.

The Spanish railway industry operated under competitive conditions from 1848, date of the opening of the first railroad in the country, to the summer of 1936. After this period, railroads were either stalled or destroyed by the Spanish Civil War, and when the war ended in 1939, Franco's dictatorship decided to nationalize most of the companies and to group them into a State-owned company that still exist nowadays, RENFE.

During the period of this study, the rights to build and exploit railroads were assigned by the government through a downward auction mechanism. The company that presented the least costly project and required the smallest subsidy was granted the right to build a railroad and a 99-year concession for its exploitation. Competitors did not have the right to build a track serving the same itinerary but they could serve the same stations indirectly. For example, only one company had a direct railroad from Madrid to Zaragoza, but another company offered the possibility to go from Madrid to Zaragoza through Valladolid and Burgos. When two companies served the same city, they could decide to connect their tracks and share a station or to locate in different stations and operate independently from each other.

Formal cooperation agreements were required when two companies shared a station and had connected tracks, as they needed to coordinate on schedules in order to avoid accidents, on costs derived from the use of the station, and on fares, in particular when clients were requiring transportation from a station belonging to one of the network partners to a final destination served by the other partner and transited by the shared station. In this setting, although they had different ticket offices, the companies used the same buildings, operated jointly all the services (such as restaurants or luggage delivery), and had agreements to charge passengers the same fares (Tedde de Lorca, 1978). These agreements were very similar to those observed in airline code-sharing agreements, in which two companies appear to compete by selling tickets for separate flights serving the same routes, but establish agreements to jointly operate on these routes and avoid competing with each other (Ito & Lee, 2007).

When two companies operated from the same city but did not engage in formal cooperation, competition between them was more intense, not only when they served the same cities, but also when they offered different roads of potentially similar characteristics. Similarly to what has happened in the last decade with low-cost airlines (Shaw & Thomas, 2006), the availability of flights to once-remote locations increased the overall demand for flights. In the context of Spanish railways, firms that cooperated in a specific location by sharing a station also competed inside the station to sell tickets and provide freight services to the same customers and companies. Thus companies that served different destinations competed for the same clients based not on the ability to reach a specific final destination but based on prices and economic potential of the possible destinations (Artola, 1978). The fact that railways in situations of monopoly on specific destinations often lowered their fares to resist competition from other railroads serving different geographic points provides evidence regarding this competitive situation (Pascual Domènech, 1999).

The decision to cooperate was not positively related to the distance over which companies were in contact: when two companies served the same cities, some decided to share stations, but in other cases, they built tracks that operated parallel to each other over miles. The most extreme case occurred in the Valencia area (Eastern Spain) where two companies had parallel tracks for 184 km (Vía-Libre, 1993).

Some companies adopted a mixed strategy with their partners: in some places, they shared a station and cooperated actively, but in other cities they had separate stations and competed with each other. Since the cost of building and maintaining a station was likely to be higher than the cost of coordinating in another station once a first coordination agreement had been signed, these strategies must have brought some benefits in terms of increased income with respect to strategies dominated by cooperation. This is what I try to assess here.

METHODS

Data

I used an original database including the 146 railway companies that operated in Spain at some point during the period 1848-1935. I gathered data on all the companies operating during this period from annual directories of the sector created by Enrique de la Torre (La Torre, 1893-1935), an engineer employed at the largest railway company. For years previous to 1893 I gathered information from the two weekly journals of the industry, the *Gaceta de los Caminos de Hierro* and the *Revista de los Caminos de Hierro*. All of the companies in the Spanish railway population transported passengers (although 2 companies in my dataset operated for a few years with freight only before including passenger service) and most transported freight as well, with the exception of some short-distance suburban companies that were dedicated to passenger transportation only.

The number of railway companies operating in Spain varied between 1 in 1848 and its maximum number of 94 in 1928 and the network length reached 16.615 km at the end of my time frame. The evolution of the density of railway companies and the total railroad length over this period are represented in Figure 5 (p.54 in Chapter 3).

Variables

The objective of my model is to measure the effect of competition- and cooperation-dominated coopetitive strategies on profitability. I measure the dependent variable, profitability, as the yearly *net income* of railway companies, which I extract from La Torre directories and other secondary sources (Muñoz Rubio, 2006).

My independent variables measure the coopetitive strategies adopted by the railway companies. As I mentioned in the previous section, coopetitive ties existed between railway companies that agreed on operating from the same station and coordinating on schedules, fares and use of tracks, while competing to capture customers in the area. When two organizations operated from the same city, they chose to cooperate in approximately 59% of the cases. In some of these instances, the railway companies had various contact points. Some chose to cooperate and share stations everywhere, but in many instances, they cooperated only in some cities and had different stations in other areas. I consider that companies use a *cooperative-dominated* strategy when they have cooperation agreements in all the cities that they jointly serve and that they use a *competitive-dominated* strategy when they have cooperation agreements in some cities and have different stations in others. I extracted information on these strategies from the localization of each company's roads and stations (Muñoz Rubio, 2006) and my variables are the count of these relationships for each railway company.

In order to test the effect of these strategies at different density levels, I also used the interaction of the strategies variables with the density variable in my models.

Controls

I included a series of organizational and industrial control variables which also affect a firm's profitability. I controlled for the profitability of the company in the previous year and for its age. The age of a company was measured as the time (in years) since the opening of a company's first railroad and was taken from La Torre directories and Muñoz Rubio (2006). I took into account the date of opening because many of the railroads that were assigned through auctions never got built, or the companies that owned the rights for its exploitation sold it before the opening, either once the railroad was built or during its construction, so that I could not use the concession date as an indicator of operation in the railway industry.

I also controlled for the attractiveness of a specific area, by indicating whether there were other railway companies operating in the area that did not have relationships with the focal firm. Among the environmental variables, I controlled for the effect of crowding and legitimation effects in the population, measured through population *density* in any given year (Carroll & Hannan, 1989). I also included an indicator of the economic activity in the country, the growth rate of the Gross Domestic Product. This series was taken from Carreras and Tafunell (2005).

RESULTS

Table 5 shows the means, standard deviations, minimum and maximum values, and correlations of the variables used in the model.

Table 5: Descriptive statistics and correlation matrix

	Mean	**S.D.**	**Min**	**Max**	**1**	**2**	**3**	**4**		**6**	**7**	**8**
1. Net Income	2.85e+06	1.21e+07	-5.54e+06	1.24e+08	1.00							
2. Population density	70.90	22.58	2.00	94.00	-0.02 (0.21)	1.00						
3. Cooperation-dominated strategies	1.75	2.89	0.00	28.00	0.88 (0.00)	0.09 (0.00)	1.00					
4. Competition-dominated strategies	0.46	1.33	0.00	11.00	0.89 (0.00)	0.07 (0.00)	0.81 (0.00)	1.00				
5. Concentration	64.40	5.26	57.36	100.00	0.01 (0.67)	-0.68 (0.00)	-0.07 (0.00)	-0.03 (0.10)	1.00			
6. Attractiveness of the area	1.22	2.24	0.00	15.00	0.80 (0.00)	0.03 (0.13)	0.67 (0.00)	0.78 (0.00)	-0.02 (0.38)	1.00		
7. Age	22.10	15.86	1.00	82.00	0.34 (0.00)	0.41 (0.00)	0.38 (0.00)	0.35 (0.00)	-0.14 (0.00)	0.32 (0.00)	1.00	
8. Growth rate	0.02	0.04	-0.12	0.12	0.00 (0.88)	0.09 (0.00)	0.00 (0.87)	-0.00 (0.85)	0.04 (0.02)	-0.00 (0.97)	0.04 (0.02)	1.00

The analysis is performed on a panel of 134 firms (of the 144 companies that operated form more than two years in the Spanish railway industry at some point between 1848 and 1935) for which I have an average of 24.8 years of data.

I estimate the relationship between cooperation- and competition dominated coopetitive strategies and net income in the Spanish railway population through a Generalized Estimating Equations (GEE) model (Hardin &

Hilbe, 2002; Zeger, Liang, & Albert, 1988) with an autoregressive correlation structure of order 1. The results of the estimations are shown in Table 6.

Model 1 only includes the control variables, Model 2 includes the independent variables that capture coopetitive strategies, and Model 3 adds the interaction of the strategies with the density levels in order to test my hypotheses.

Table 6: GEE Estimates of the net income of Spanish railway companies

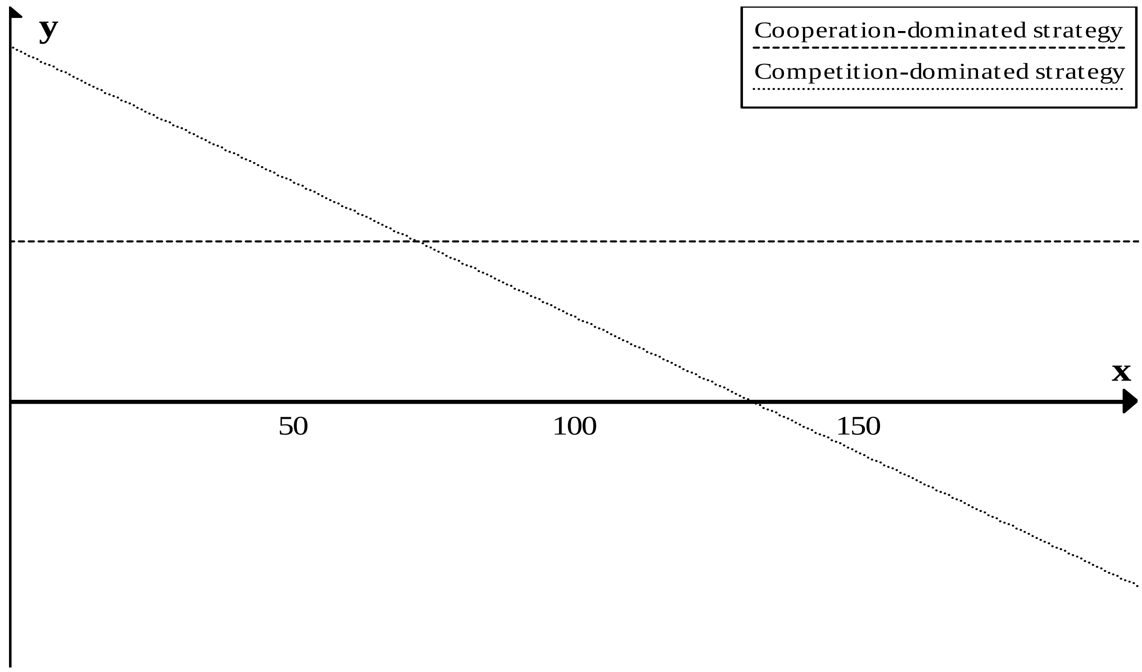
Variables	**Model 1**	**Model 2**	**Model 3**
Net income $_{t-1}$	0.98*** (0.00)	0.93*** (0.01)	0.93*** (0.01)
Population density	-5,654.99*** (1,736.78)	-8,404.12*** (1,786.12)	-7,166.80*** (1,984.08)
Cooperation-dominated strategies		156,985.76*** (20,384.18)	202,561.77*** (61,469.63)
Cooperation-dominated strategies * Density			-462.32 (810.46)
Competition-dominated strategies		178,246.52*** (47,374.27)	449,979.35*** (129,517.70)
Competition-dominated strategies *Density			-3,422.89** (1,692.09)
Concentration	-10,220.57 (7,162.18)	-11,333.83 (7,230.34)	-13,405.17* (7,310.40)
Attractiveness of the area	118,541.10*** (19,625.24)	124,186.63*** (20,681.26)	125,545.30*** (21,010.89)
Growth rate	1,223,022.94* (736,746.41)	1,238,918.14* (725,609.32)	1,277,031.05* (724,961.82)
Age	-454.52 (1,993.95)	-1,699.54 (2,023.43)	-1,831.79 (2,019.04)
Constant	1,006,926.72* (552,219.39)	1,083,584.69* (558,400.17)	1,107,857.40* (568,902.20)
Number of observations	3322	3322	3322
Number of firms	134	134	134
Wald Chi2	208,350.76***	203,433.75***	204,580.79***

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The fit of the models is best for Model 3, which includes all the strategies and their interactions with the density measure. I find that profitability is positively and strongly related with previous performance. The results also indicate that the density level reduces the net income of the railway companies (coefficient equal to -7,166.80 in Table 6, significant at the 1% level), but that local density of other railway companies ("attractiveness of the area" in Table 6) is positively related to the income, showing that it is more profitable to locate in the area of the market that is denser in customers and resources even though there is intense localized competition in that area. Age does not have a significant effect on performance, and economic growth is only weakly related to superior profits (the coefficient is positive, but only significant at the 10% level).

I find support for hypothesis 1: competition-dominated coopetitive strategies increase the companies' net income (coefficient: 449,979.35, significant at the 1% level), but the effect decreases and eventually becomes negative as density gets higher (interaction term: -3,422.89, significant at the 5% level). I only find partial support for hypothesis 2: cooperation-dominated coopetitive strategies increase a company's income (the coefficient is equal to 202,561.77 and significant at the 1% level), but the effect does not vary with density. However, given that competition-dominated coopetition and having no coopetitive relationships both become detrimental strategies at high density levels and that the hypothesis that the effect of cooperation-dominated relationships on performance was equal to the effect of competition-dominated relationships was rejected in Models 2 and 3, I find that the companies in my sample would be better off by choosing competition-dominated coopetition when the density is low and cooperation-dominated coopetition when the density is high. This situation is illustrated by Figure 7.

Figure 7: Marginal effect of an additional cooperation- or competition-dominated strategy under different density levels



I also find that the difference in the performance generated by these strategies is significantly different from zero, and that the main effect of the competition-dominated strategies on performance is superior to the effect of cooperation-dominated strategies.

DISCUSSION AND CONCLUSIONS

In the Spanish railway industry I can easily track the coopetitive contacts between all operating firms. Thus, I am able to measure the impact of different coopetitive strategies on financial performance for small and large firms over a long period of time.

Firms maintain coopetitive relationships characterized by intense competition, and not full commitment, between partners because these relationships lead to superior performance. This finding goes in line with the idea that both cohesion and structural holes are beneficial in networks (Gargiulo & Benassi, 2000). It could be the result of higher bargaining power in competition-dominated relationships, or of over-embeddedness in cooperation-dominated relationships, particularly in this specific setting in which the fixed costs of building a track make the ending of a partnership very costly and difficult.

However, as the market becomes crowded, coopetitive relationships that are characterized by intense cooperation and reduced competition become more profitable. This is consistent with the fact that higher density levels mean that the overall competition in the industry is intense (Carroll & Hannan, 1989), and a good means to mitigate the negative effects of competition that erodes profit margins is to engage in cooperative relationships characterized by commitment and trust.

This study presents a number of limitations: I make a distinction between two possibilities for coopetitive strategies, cooperation- and competition-dominated strategies, while it is very likely that there is a wide range of possibilities in between. Thus, companies that share ten stations and compete in one city by not sharing a station would be treated here as engaging in a competition-dominated strategy. Fortunately, this situation never happens in the population, and when two companies cooperate and compete in different cities, the number of stations in which they perform one or the other strategy is roughly equivalent. Secondly, I do not have detailed accounts of the competitive moves made by each company in the cities in which it has competitors, and thus I am unable to track the evolution of competition over time and under different competitive structures. This would be an interesting issue to examine in a future study.

Overall, the contribution of this paper is to show which strategies are beneficial under different industry structures. The main results are that competition-dominated and cooperation-dominated strategies are both an important means to increase financial performance[5], that competition-dominated strategies are usually more profitable than cooperation-dominated strategies but that they lead to increasingly lower profits as the market becomes crowded. We also find that this effect is due to crowding on the market, and not to concentration and the fact that some firms dominate the market and extract most rents. Another important contribution of this paper is that it uses a database that includes all the relationships between companies in a single industry, thus allowing me to perform a quantitative analysis and to include small, less successful firms, instead of focusing on a few salient cases, in general for large, very profitable organizations, which is what most previous qualitative and quantitative studies on coopetition within an industry have been doing and has limited the practical implications that can be drawn from the coopetition literature.

[5] This could explain the result in Chapter 3 that firms sometimes engage in cooperative relationships that harm their long-term survival chances: they choose this strategy because it increases their short-term financial performance.

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Chapter 5 - Conclusions

This dissertation has analyzed the impact of interorganizational relationships on short-term and long-term organizational performance. All the papers are based on quantitative analyses of a database that was constructed for this thesis, and which includes economic information on all the railway companies that operated in Spain since the beginning of the industry in 1848 until the Spanish Civil War.

The first paper in this dissertation examines the impact of direct relationships, between firms that directly interact with each other, and of diffuse relationships, between firms that operate in the same industry but that do not have direct relationships, on organizational relationships. This chapter contributes to the literature in population ecology and shows that localized competition and cooperation between firms respectively increases and reduces mortality rates, but that the impact of diffuse relationships persists after controlling for all direct relationships.

The second paper examines in a more detailed fashion direct relationships between firms and assesses the impact of these relationships on mortality, depending on the organizational form of the companies that cooperate with each other. It contributes to the literatures in social networks and population ecology by showing that connections between firms have different benefits depending on the identity and resources of each connected organization. In particular, it shows that some cooperation strategies can generate a liability of connectedness by hindering the long-term survival chances of the organizations that engage in such strategies, and that the effects of connections can be asymmetrical for the connected partners.

Finally, the third paper examines the effect of different coopetitive strategies on the financial performance of Spanish railway companies. It shows that strategies that are dominated by competition lead to higher financial performance than strategies that are dominated by cooperation, but this effect decreases as the number of competitors in the industry increases. This paper contributes to the strategy literature in general by showing which strategies are beneficial under different industry structures, and to the literature on coopetition in particular by using a database that includes all the relationships between companies in an industry over a long period of time, instead of focusing on a few salient cases as most previous studies on coopetition have done.

This dissertation presents a number of general limitations. First of all, most firms carried both passengers and freight, but presented very important differences in the relative intensity of the two activities. However, the information on the number of passengers transported each year was much more complete than the information on freight activity, and was consistently reported in the same unit, whereas figures on freight were reported by different companies as weight of the goods transported or as total amount charged, which did not enable comparisons. Since the number of passengers was strongly correlated to the tons of freight transported when the information was available, and very strongly correlated to income in all cases, I believe that this is not a major problem in this setting.

A second issue is that the ties that I discuss throughout the three essays are not randomly assigned, but result from the decisions of firms, which are themselves constrained by the initial decision to locate in a specific geographic area. A third related limitation is that I did not explain in this dissertation the mechanisms behind the formation of ties between railway companies. However, it seems that the decision to engage in cooperative ties is not driven by differences in performance with respect to similar firms, and the pattern of results is consistent with what could be expected if the ties were randomly assigned.

Another limitation of this dissertation is that I have only focused on the effect of direct, dyadic ties between partners, and not on the benefits that indirect ties could provide. Adopting a network perspective on the issues discussed in the three essays would be an important development.

Finally, the result that managers in railway companies engaged in ties that harmed the survival chances of their firms seems inconsistent with the idea that managers are fully or boundedly rational. However, the third essay shows that it is not necessary to assume any kind of irrationality of the railroad managers to explain these relationships: the same cooperative ties that could create a liability of connectedness often led to superior financial performance.

This dissertation opens different avenues for future research. The first essay highlights the importance of disentangling direct and diffuse processes, but does not show how these processes interact with each other. However, the second and third essays show how the strategic decision of locating in a specific area and engaging in ties with other competitors in a sector is affected by population-level forces that are beyond the direct control of managers. Thus, I intend to examine the interaction of the different processes. Furthermore, in order to disentangle direct and diffuse processes, it would also be useful to distinguish between diffuse competition and diffuse legitimation, which are usually both measured by density. I intend to gather data on more specific dimensions of legitimacy in the sector in order to do so.

The second essay offers interesting results on the effect of ties between asymmetric partners, an area that has received very little attention in previous research. While in this essay, I have only looked at asymmetries that result from the organizational forms of the partners, other types of asymmetries are likely to lead to similar patterns. Here, I have only examined the effects of dyadic ties, but asymmetries in the network to which different partners get access through connections are also likely to impact performance.

The third essay shows the benefits of analyzing in greater depth the possible variations in intensity of competition and cooperation between alliance partners. While I have done a first step in this direction, there is a large range of possibilities that has not been addressed in the paper, and which need further analysis.

As I have mentioned earlier, in the three essays, the ties that affect short- and long-term performance are not randomly assigned, and the explanation of the mechanisms leading to their formation also needs to be examined in future research.

Finally, the diffusion of management practices between companies that were connected to each other is another important consequence of interorganizational relationships. In the railway industry, diffusion seems to have occurred first between French companies and their Spanish subsidiaries, and then to have shaped the practices in the Spanish industry through ties, because the cooperation agreements between companies lead to intentional and unintentional convergence of different management aspects. The examination of company reports in search for possible network externalities in the diffusion of practices is another interesting area for future research.

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